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ESSAYS

ON

AGRICULTURE,

BY THE LATE

THOMAS GISBORNE, Esq.,

OF YOXALL LODGE, STAFFORDSHIRE.

REPRINTED, BY PERMISSION, FROM THE QUARTERLY REVIEW.

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1. CATTLE AND SHEEP.
2. AGRICULTURAL DRAINAGE.
3. ANCIENT AGRICULTURAL LITERATURE.
4. HIGH FARMING. AN UNPUBLISHED FRAGMENT.

WITH MR MURRAY'S COMPLIMENTS

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1854.

S455
G5

PREFACE.

The Author of this volume of "Essays on Agriculture," the late Thomas Gisborne, of Yoxall Lodge, Staffordshire, was born in 1787, and died in 1852. He was an extensive landowner in the counties of Stafford and Derby; he personally farmed a considerable acreage of arable and pasture land, and was especially conversant with the dairy and with cattle and sheep feeding. Mr. Gisborne was also well acquainted with the agriculture of Scotland, both Lowland and Highland. Few agriculturists of his day were more generally known in their class; few men, in public or private life, were more beloved. His talents, his various attainments, his warm heart and popular manners, his ardent love of field sports, made him the delight of numerous friends. A Member of the British House of Commons for a quarter of a century, he was well known as a "public man," and his speeches and pamphlets on various subjects were numerous; but it is the purpose of the present volume, simply to collect, in their entirety, his valuable writings on Agriculture.

The first three Essays were written by Mr. Gisborne in 1849 and 1850, and originally appeared in Nos. CLXVIII., CLXXI., and CLXXIII., of the *Quarterly Review*. The article on *Agricultural Drainage* was subsequently carefully revised by him, and separately published by Mr. Murray, in 1851, passing rapidly through two editions.

The proofs of this first reprint were submitted by the deceased Author to the further revision of his schoolfellow

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and neighbour, the late Sir Robert Peel, who, on the system and under the superintendence of Mr. Josiah Parkes, had early deep-drained his Drayton estate. An extant private letter from that eminent statesman to Mr. Gisborne, dated Whitehall, 26th June, 1851, is not only a high testimony to the value of this Essay, but an interesting evidence of the earnestness and sagacity of Sir Robert Peel, amidst the distractions of public life, on subjects affecting the progress of agriculture. The following is an extract:—

> "I do not think the article admits of improvement by addition; certainly not by omission. Would it be easy to present engraved plans and sections of the ordinary four-foot Drain for the reception of 1½-inch Pipe; and of the Tools used in making the Drain and laying the Pipes and Collars? Some people understand such an appeal to their Senses in half the time they comprehend one to their Reason.—Many of those who drain extensively neglect to have a *plan* of the Draining of each field made at the time that the work is done: a hint as to the advantage of this might be advisable."—

Mr. Gisborne had intended a similar revision and re-publication of the articles on *Cattle and Sheep* and *Ancient Agricultural Literature;* but death intervening, they are now reprinted as they originally appeared in the Review, with the addition only of the Tables of Contents.

The fourth Essay, on *High Farming*, is a posthumous publication. It was written in 1851–2, and designed for the same channel of publicity. A printed proof of "High Farming" was found in his Study; but the latter part appears not to have received the Author's final correction, nor had it then been fully approved by the Editor of the Review.*

Mr. Gisborne had also meditated a succession of articles on other agricultural topics, which would doubtless have been composed and published, had his life been spared. There is reason to believe that the earliest paper he contemplated was one on "Woods and Plantations." He had also intended, at the suggestion of the Earl of Lonsdale, a dissertation on the "Revival of Agriculture in Britain"—considering that a decided era was ascertainable; and the history would have been carried down to, and have embraced, the introduction and development of the turnip and green crop systems of farming, which constitute the grand basis of improvement and progress in British, as contrasted with the declension of Roman, Agriculture, so clearly traced and described in his Essay on "Ancient Husbandry."

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* The proof is endorsed by Mr. Gisborne as "corrected," so far as the last paragraph in pages 235–6 of this volume.

The above circumstances—of the degree of ultimate revision of the respective Essays by their Author—are thus particularly stated, because some of his views are subjects not only of pending discussion and difference of opinion, but of naturally important and enduring interest. Truth and public enlightenment, however, were the sole aim of the writer, and if now alive, he would have honestly abandoned any demonstrated error; he scorned sinister falsehood and ignorant prejudice, and he had little sympathy with their victims.

The sterling merit and popularity of these remarkable contributions of Mr. Gisborne to the periodical literature of his times, amply justify the collection and republication of his Essays in a complete and permanent form. It is a vulgar error to regret that eminent literary men of the present age should have "wasted" their labour as "writers of reviews." No greater fallacy has been current. Even the minor periodicals are in some sort the nurseries of national literature. They are essentially cosmopolite, as the medium of much foreign communication with the Republic of Letters. The higher class of Reviews maintains the standard of a higher literature, and contributes to the purification of the public appetite and taste for knowledge, and it creates and trains up a certain number of superior writers. Perhaps, in no instance, can it be proved that Contributors of any class have, in consequence, failed to make the best use of their faculties and accomplishments. On the contrary, the attraction and remuneration of Reviews largely increase and encourage the productions of authors, and open new markets for books. A Reviewer tests his own powers, and perfects them in a leading periodical; and Time, by the accumulation and reprint of his contributions, gives him a permanent celebrity and the widest sphere of influence. It is scarcely necessary to cite the increasing number of such Essayist collections in our own days, not excluding "Essays from the *Times!*" Such authors become instructors of Posterity.—Thus the living names in our own generation of Walter Scott, Southey, Arago, Jeffrey, Hazlitt, Mackintosh, Sydney Smith, Brougham, Guizot, Thiers, the two Mills, McCulloch, Senior, G. C. Lewis, Macaulay, Croker, Wilson, James Stephen, Lord Mahon, and Albany Fonblanque, are fixed stars in the firmament of literature.

The liberality of the Proprietor of the *Quarterly Review* permits the present publication. The *political* opinions of Mr. GISBORNE, it is well known, were not in accordance with the principles on which that able Periodical is politically conducted. Nevertheless, the sagacity of its Editor discovered in Mr. GISBORNE, and used on common ground, a highly-gifted Contributor, whose mental labours might otherwise have never seen the light. These mutual relations constitute real liberality; may they be everlasting!

The entire Agricultural and Political Essays and Speeches of Mr. GISBORNE, in Parliament and "out of doors," with a brief memoir of their author, are in the press, and will be early published. In the meantime this portion, exclusively of Essays on Agriculture, cannot be unacceptable to the Land Owners and Tenant Farmers of Great Britain and Ireland. The proprietors and tillers of the soil must now rest solely on themselves; their future and profitable success, as citizens of the world, depends on their own individual exertions and improvements. The contests between "Protectionists" and "Free Traders" are exhausted discussions. Agriculturists can henceforth only ask the Legislature for Fair Play, in acts of free trade for *all* classes. The personal life of Mr. GISBORNE was, for nearly half-a-century, connected with the stirring events and party-spirit of his day; but in all his writings on Agriculture, and in his speeches at Farmers' Meetings and Agricultural Societies, he ever avoided controversial politics. On such occasions and times, Agriculture was his only text; his single object the advancement of the Art of Husbandry.

H. S.

Yoxall Lodge, Staffordshire,
20th October, 1853.

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CATTLE AND SHEEP.

WE purpose to confine ourselves on the present occasion to that department of agriculture which is engaged in furnishing a supply of animal food to the inhabitants of these realms. Though we trust that we may be pardoned for offering to our readers, almost exclusively, statements and remarks drawn from our personal experience and observation, we hope it will not be supposed that we are indifferent to the rich and interesting literature of contemporary agriculture. Mr. Stephens' "Book of the Farm"* (of a new and improved edition of which one volume has just reached us) is only one of several comprehensive Manuals that have been received with very general approbation by the classes best able to judge of their merits. The agricultural magazines published on both sides of the Tweed may well be referred to with satisfaction, as evidences of the spread of curiosity and speculation as to all questions connected with this great department of national industry; and though neither France nor Germany has of late been sterile in the same line, we believe we may safely say that foreigners are ready to admit, as yet, the superiority of this branch of our insular manufacture. At any rate, the great extent to which their best writers rely on the facts and reasonings of ours, cannot be questioned. Nor can it be denied that this rapid succession of dictionaries, treatises, pamphlets, journals, and the large circulation which many of them deservedly attain, are features of the time—and features somewhat remarkable when we call to mind that, within the memory of living men, agriculture had scarcely advanced since Virgil wrote the Georgics; that the volumes of Tull and Arthur Young were the only agricultural publications which could be found in an English farmer's library, even where such a phenomenon existed; and that in the department of cattle-breeding, in which we have now distanced the rest of the world, the Roman poet appears to have had much the same perception of the cardinal virtues of a bull or cow, as most of the practical British farmers of those generations which preceded Collins and Bakewell.

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* "The Book of the Farm; detailing the Labours of the Farmer, Farm Steward, Ploughman, Shepherd, Hedger, Cattleman, Fieldworker, and Dairymaid." By Henry Stephens, F.R.S.E. Second Edition, in 2 vols., with numerous Illustrations; 8vo.; Edinburgh and London, 1849.

Up to their time cattle and sheep were produced according to the generosity of the land on which their lot happened to be cast. Perhaps we owe it to difficulties of internal communication that very distinct races maintained, in some districts of small extent as compared to the surface of Great Britain, a separate existence. Over the rest of the country some little attention was paid to the qualifications of the ox as a beast of draught, but beyond this the cow was merely a milk and calf producing animal. The bull was selected for his proximity, and his best recommendation was that he had given sufficient evidence of the talent which Mr. Shandy desiderated in Obadiah's grave pet. "Their bull gendereth and faileth not." When he had served the parish in this capacity for three or four years, he was discarded from a prevalent and probably well-founded idea that uncanonical connexions were, on more than one account, inexpedient. He was then marched off to Stilton or Porchester Castle to feed French prisoners; or, if his size and substance were favourable, he was degraded into an ox, and took his place in the team. Of his progeny, the males, with the exception of a successor or two in his own vocation and a few oxen for the plough, were made into very immature veal. The females were reared. Such as were seasonably prolific, and as showed milking qualities, succeeded their mothers in the dairy; and the remainder, after having been indulged with the best pasture which the district afforded, served to relieve, with the tenderness of youth, the uniformity of old cow beef which formed the staple supply of the provinces.

Of the pure races we must speak more definitely. England preserved the Devons and the Herefords. We add, with some hesitation, the appropriately named Longhorns, which still struggle for a separate existence in a small district round the point where the counties of Warwick, Derby, Stafford, and Leicester approach each other. To fix on a known point we should say they hail from Atherstone. Some splendid horns from this race are preserved by Lord Bagot at Blithfield. As late as the year in which the General Agricultural Meeting was held at Derby a bull of this sort obtained a prize. The earliest, and that very recent, representative of the Short-horn, of which we have knowledge, was a large, uncouth, patch-coloured animal from the district of Holderness—a milk-seller's cow. Wales furnished a mean, black, mountain bullock, dignified with the name of a Runt, which still appears in considerable numbers in the markets of the western and southern grazing districts. Perhaps the improvement which has of late years been made in this race by the infusion of West Highland blood can hardly be called a cross. We apprehend that both races speak Gaelic. Scotland gave us the unquestionable West Highlander, whose head-quarters are now fixed in Argyleshire and West Perth, and the somewhat more equivocal Galloway; perhaps even the rough east country stot, from Aberdeenshire and its associate counties, may claim some *locus standi* in this enumeration. In Ireland we trace no distinctive breed. The distinction of the Irish ox and heifer was, that they were the worst shaped and worst fleshed animals which ventured to appear in an English market. "Good things scarce: plenty of Irish," became an almost proverbial description of a cattle fair. The same system of haphazard breeding, which overran a large portion of England and Scotland, prevailed universally in Ireland. As with the human, so with the bovine, race. Each endowed with a marvellous fecundity: maidens and heifers equally precocious. The same circumstances of penury, hardship, and neglect which made the Irish (not "the finest," but) the most degraded peasantry who came into permanent contact with civilization, made the Irish ox the most degraded of oxen.

So stood the case a short century ago. But a great change was at hand. The early systematic improvers of our stock took the readiest, and perhaps, under the circumstances, the most scientific, course. Having come to a definite, and, in the main, an accurate, perception of the objects which it was desirable to attain, they selected and commingled, without any regard to affinity of race, the animals which appeared likely to realize their vision. Immediate success attended their efforts. The merits of the first cross are proverbial, and even while we write, the newspapers offer us a confirmation of the proverb in the statement, that the prize ox, which this year (1849) furnished the baron of beef for the Christmas festivities at Windsor Castle, was bred by Prince Albert, was an animal of rare symmetry, quality, and fatness, and was the produce of a buffalo cow by an Ayrshire bull. In sheep, Bakewell put together white-legged and black-legged, horned and polled, long-woolled and short-woolled. Nor was the case much different in cattle. The late Earl Spencer traced much of his standard short-horned blood to a Galloway cow, which is still, we believe, a luminary of the Herd-book, and which produced one or more animals of agricultural celebrity. Still the desire for something distinctive prevailed; and as every three or four years brought a fresh generation of these animals, their fleeting series enabled a successful experimentalist to establish something of uniformity within the limits of one human life. So, from most heterogeneous materials, breeds both of cattle and sheep, having respectively distinctive qualities, were called into existence. Of either sort, one—of cattle, the improved short-horn, and of sheep, the new Leicester—obtained a decided pre-eminence. They gained a footing in almost every agricultural district of England and Scotland. The uncivilized herds and flocks of our predecessors shrank before them as rapidly as the red man before the white in the New World; and though fashion certainly pushed them into some districts for which they were unsuited, and in which they degenerated rapidly, yet in the main they have retained their conquests. No doubt they trenched on the dominion of the old and pure races. They drove in their outposts and even made inroads into their territory. Meanwhile the possessors of the old races were not insensible to the spirit of improvement which was abroad, nor to the fierce competition which was forced upon them. To them, as to men in higher station, three courses were open. They might discard their own stock as unequal to the occasion, and adopt that which the enterprise of other men placed within their reach; or, following the example before their eyes, they might aspire to success by crosses of which their own herds should be the foundation; or, thirdly, they might seek improvement by judicious selection and rejection within their own domains. Happily, they adopted the last course, and the purity of our old races of cattle was maintained. Who would not regret the disappearance of the beautiful Devon and the picturesque West Highlander? Either position or design had kept these races pure, and they retained all the distinctive marks of purity. Thus they were improved without being adulterated, and remain to this day as marked in their respective characteristics, as they were before an improved short-horn or a new Leicester had been called into existence. Their improvement has perhaps not been so rapid as that of the new breeds, but they did not start from so low a point of degradation. Nor should it be forgotten that they occupy districts below the average of the kingdom in fertility. On the whole, they have maintained the contest for superiority with various success—a success regulated perhaps at times by fashion and caprice, but resulting on the whole in good judgment and truth.*

We should now, perhaps, be in condition to estimate the results of a struggle which has continued for more than half a century. But before we can pronounce even a qualified opinion, we must have a very clear perception of the principles on which a decision ought to be founded. The real and only question for the farmer is, what breed of cattle will, year by year, yield me the largest money return per acre, or per given quantity of various sorts of food consumed by them? And this question is not settled by saying, Taken—10 tons of short-horns and 10 tons of Devons; 50 tons of food of equal quality were consumed by each lot; the short-horns gave beef as 21 to 19, or *vice versâ*. 1st. We must know the respective histories of each 10 tons; we must have a debtor and creditor account of each up to the time of weighing in. The one may have credit for services in the dairy, the other for services in the team; or the creditor side may be blank in the case of either or both. We must *here* consider the breeder and the feeder as one man. Before we can answer the question so interesting to him, we must know the antenatal cost of each 10 tons, and their respective debits and credits up to the day when they leave the hands of the beef manufacturer for the shambles. 2ndly. We must know which fetched the most money—the beef represented by 21, or that by 19. It is easy to say, "I have bred a beast of rare symmetry, great size, early maturity, first-rate quality." Equally ready are the inquiries, "After how many failures?—At what cost?—How stands the balance?" These questions are answered by many brave and contradictory assertions; by many wild and contradictory guesses; but by no statistics on which we can found a safe conclusion. And, yet, on the answer depends, on average agricultural farms suited to any description of cattle, the whole question of successful breeding and feeding. The statistics are not forthcoming; first, because few farmers keep any accounts but a cash-book; and, secondly, because considerable intricacy arises from the circumstance that the breeder and feeder (in the case of cattle) are ordinarily not the same person. To those who give to the public accurate statistics of one farm, or of one animal, we are under great obligations; but the questions at issue can only be solved by a multitude of instances. Being, therefore, without the sure monition of arithmetic, and left to our own observation, aided by the opinions of men of sagacity, and finding no very definite or decided preponderance in those opinions, we are not in condition to offer to our readers any guidance on which we could safely advise them to found their practice. But, we may mention some of those characteristics of the various animals which we have under review, which must be important points of consideration whenever increased knowledge shall enable us to bring the main question to a definite issue. Before we do so, we may be allowed to premise, in a single sentence, that in the breeding of cattle—as in every other important human pursuit—national objects are promoted by the successful skill and industry of individuals. The first vocation of a cattle-breeder is to furnish his countrymen with the dairy; with all its multitudinous comforts and luxuries. We scarcely know a more important national object of its class, than to place a free supply of milk within the reach of the great body of our population. The next vocation of the breeder is to supply animal food—milk and animal food in the case of cattle—wool and animal food in that of sheep. Animal food is suited both to our climate, and to the hard-working energy of our people. The breeder has to cater for appetites, which bodily exertion has made rather active than critical; as well as for others, of which sedentary and intellectual pursuits have blunted the desire for quantity, but at the same time stimulated the appreciation of quality. Bearing these objects in view, we proceed to remark on those qualities of the various descriptions of agricultural animals which subserve to their attainment.

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* A split has arisen in the Herefords, of which we cannot explain the origin, but which we regret, though we cannot say that it has produced any deterioration. The difference, though small, is decided, and the respective parties are of course very positive. The general Hereford is an animal with a white face, upward horns, and a tawny side. The animal of the offset has a speckled face, generally a broad white stripe down his back, and shorter legs and more horizontal horns than his relative. Of the speckled-faced Herefords the late Mr. Price, Earl Talbot, and Sir F. Lawley have been the most distinguished breeders. The contest between speckled-face and white-face is not worth carrying on.

"Facies non omnibus una
Nec diversa tamen, qualis decet esse sororum."

From their general and hitherto progressive prevalence, the new breeds of cattle and sheep claim our first notice. We have already adverted to the manner in which (if at the expense of a little accuracy we may use the most expressive phrase) they were *created*. To the short-horns we must award the merit of uniting milking qualities with a propensity to get fat, to a degree which rarely, if ever, had been previously found in the same animal. We doubt, however, whether the mothers of the prize bullocks are the animals which fill the milk-pail. To that very simple agricultural implement is, as we fancy, to be traced the slack and bare loin which is the characteristic failing of this breed. In the shambles at Birmingham, where a large proportion of the well-fed cows from our dairying districts are slaughtered, you may generally perceive the blue and bare spot on the loin, though the rest of the carcass is loaded with fat. The advocates of the new breeds claim for them, that with a given amount of food, and in a given time, they will yield a larger weight of beef and mutton than animals of the old races. With some qualification we are prepared to admit the claim. In the case of selected individuals, previously brought to a certain age, or point, of maturity, we think that the claim is well founded. Our qualification has reference to the previous history of the animals. As we hinted above, we must begin at the beginning. We have no doubt, we might almost say experience has proved, that if 1000 short-horned females were subjected to the breeding process in competition with 1000 West Highlanders, Devons, or Herefords, not only in the first named would there be more failures of produce, but among the products there would be more animals of low quality, coarse, and utterly exceptionable, than would be the case in any of the three old races. As little doubt have we that 1000 Leicester ewes would produce fewer lambs, and among those fewer more rickety, wry-necked, and turn-in-the-head, than 1000 ewes of any other breed. This is because, though art may improve upon nature, it never can become so unvarying and sure in its operation. The varieties and incongruities which have been introduced on account of their connexion with some coveted quality, will from time to time re-appear. The concoctor of a new breed is always liable to disappointment. He introduces into his herd some unknown animal on account of certain apparent excellences, but he cannot tell what qualities, though latent in the individual, run in the blood. The flat side, vulgar head, or hard flesh of some paternal or maternal ancestor may re-appear in the offspring. We have heard Mr. Buckley of Normanton, the owner of one of the oldest and purest flocks of Leicester sheep, say that, from time to time, gray faces and black feet appeared among his lambs. We have before us a letter from the late Earl Spencer to a friend, who had consulted him on a point in breeding, in which he says, "Your cross will not justify a very high-priced bull, but in order to secure you against *anything monstrous* in his stock, you must ascertain that you have several generations of real good blood." With such incidents a breeder of horses is familiar. He selects a bay mare with black legs, and unites her with a male having the same characteristics. If the produce should be chesnut, with a bald face, and what the dealers call white stockings, we can assure him of sympathy from many fellow sufferers. To disappointments of this class the proprietors of original, or very old, races are less liable. Every connoisseur in cattle is aware that in a drove of short-horned bullocks or heifers, there will be more diversity of shape, of quality, of colour, and of aspect, than in a corresponding drove of West Highlanders, Devons, or Herefords. Another difficulty besets the breeders of short-horns, and all others who have attained to animals of great merit by many mixings and crossings. You have selected the breeding stock for size, symmetry, propensity to fatten, or for what a Frenchman would call, a "*je ne sais quoi;*" and a breeder, a sparky appearance. When you have secured the recurrence of these qualities in their offspring, as far as bovine frailty permits, you have invariably attained this object at some sacrifice of fertility. We have known some breeders of short-horns who have been, and perhaps still may be, desirous of having bulls with the heads of heifers and the thighs of bullocks. The offspring of such males is always deficient in quantity, and is of weak constitution; the progeny inherits the paternal effeminacy. When such a blunder has established itself in a herd, it can only be redeemed by recurrence to a male,

> "cui turpe caput, cui plurima cervix,
> Et crurum tenus à mento palearia pendent."

These are the true and natural indications of taurility.

Our lamented friend, Mr. Edge of Strelley, having shaped in his imagination a breed of cattle formed on his own model, great size, symmetry, and a propensity to fatten, spared no expense to realize his vision. Aided by a most correct eye, and with no prejudices, personal or local, he selected at any cost, and from any quarter in which he found them, the animals, both male and female, which he thought likely to answer his expectations. Nor was he disappointed in the qualities of their offspring.

But after some years, when he seemed to have attained, or to be on the point of, perfection, he came to a dead lock; his females, though much solicited, refused to give him produce. On this ground, and on this only, we believe, he broke up his herd and discontinued the pursuit. Lord Spencer, an enthusiastic advocate of short-horns, admitted in more than one public speech that, in his herd, fecundity had diminished to an inconvenient degree, and was only maintained by a degree of care and attention which could hardly be extended to the general breeding stock of a kingdom. We know the ready answer—The females are too fat. But that is not the whole question. We lately inspected a herd of Herefords, the property of a distinguished and (we speak on the authority of his farming accounts) very successful agriculturist. The breeding cows and heifers, living solely on crushed gorse, were considerably above the point of marketable beef in fatness. We have no doubt they would be very bad milkers. The bulls were loaded with fat; but there was no deficiency of calves; the drafts on account of barrenness were very few. The expression of the owner was, "I have no trouble on that score." Twins were by no means unknown in the herd. Since short-horns have been very generally introduced into the midland counties, barrenness has been a great "trouble" to the cheese-making farmer.

We will endeavour to sum up impartially. Even the improved short-horn is by nature a coarse animal, requiring a good climate and a generous soil, and unprofitable for *merely* feeding purposes. Sterility is a serious tax on any herd which, by great care and attention, has attained to a respectable quality of flesh, and to symmetry of form. The dairy sustains the short-horns. The cast cows soon acquire a rough coating of fat, and form a valuable supply of low-priced beef for the manufacturing and colliery districts—for those appetites which we have described as being active without being critical. But we should be unjust if we did not assign to the short-horns one quality of great value in an agricultural animal—composure of mind. The males have lost the combativeness of their species. We can hardly conceive a more ludicrous sight than a bull from Althorp, or Babworth, thrust into the arena at Seville, or Ronda. The females yield precedence without contest. If you introduce a little petulant Highland cow into a dairy of short-horns, of which every individual is double her own weight, she at once becomes mistress and leader of the herd. We have been in the habit of attending annually a sale of fat cattle where the stalls are filled with beasts of various descriptions. The short-horn is released from the stake to which he has been tied for four months, and proceeds to the hammer with all the solemnity which befits an animal who is walking to his own funeral. The West Highlander, as soon as he ascertains that he is free, rather in frolic than in fury breaks through the ring of his intending purchasers, blunders over a fence, and celebrates his recovered liberty by most extraordinary antics. The butchers get but a passing view of him. "Now, gentlemen," says the facetious auctioneer, "you must shoot him flying." His sale proceeds without the solemn pinching and punching, and the wise looks which, in the case of a more patient animal, arė preliminary to a bid. Some excitement has been produced by the scene, and, if the gin-bottle has done its duty, he generally sells well. But we beg pardon.—We must not altogether pass by the important point of early maturity. Here the short-horns claim a decided pre-eminence. We will not altogether negative the claim, though we do not find it borne out by the declared ages of the animals which are exhibited for prizes at the Smithfield show. We only desire to ask and to receive candid answers to two questions, and, in order that we may dismiss the subject, our questions shall have reference to new Leicester sheep as well as to short-horned cattle. Have, or have not, these two breeds possession of the most fertile districts which are devoted to breeding? Have they, or have they not, during their two first years more indulgence than falls to the lot of the young of other breeds?

So many general points have entered incidentally into this review of short-horned merits, that we can be more concise respecting the old races. We will take Devons and Herefords together as having many points in common. They are confessedly prolific; neither are suited to a farmer whose rent is to be made by the produce of his dairy; we reck little of the services rendered by their bullocks in the team; human labour must be at a low ebb where it can be profitably associated with so slow a beast as an ox; bullock-teams and railways will not, we think, long co-exist. We must admit that something will be sacrificed, for we are not insensible to the superior quality of meat of mature age. The claims of these two races are founded on good constitution, on the very rare occurrence of animals without merit, on a considerable capacity to bear hardship without suffering, on symmetry sustained with less care than in any artificial breed, and on the high quality of their beef. When their symmetry does fail, it is generally in the fore quarters; where the high-priced beef lies, they seldom fail. They are unrivalled in the deep cut of lean meat well covered with fat along their whole top and sides, which butchers find so acceptable to their best customers. If compelled to give a decision between the two races we should say, with much hesitation, "If you wish to please your eye, take the Devons; if your pocket, the Herefords."

We approach the West Highlander with some fear, lest we should ramble into romance instead of adhering to plain agricultural truth. How can any man leave either his garret in Grub Street, or the tails of a set of lumbering short-horns in a Lincolnshire homestead, to visit the free and spirited denizen of Gare Loch Side, Glen Lyon, and the storm-swept Hebrides, without feeling some excitement? Unless the West Highlander has gazed on you from a rocky knoll in his native glen—unless you have felt how much he ornaments and animates the scene, you will not admire and love him as we do. The first merits of a West Highlander are his hardihood and his great industry. Whether you order him to find his living on a black moor in summer, or to gather up the crumbs which have fallen from the rich man's table on your feeding pastures in winter, he is equally prosperous and cheerful. In storms or severe weather you never see him setting up his back and shivering under a hedge or wall; he is constantly working for his bread. We knew a grazier who always cleaned up his pastures in winter with West Highlanders, and who objected on principle to giving them any fodder, even when there were several inches of snow on the ground, saying that it only taught them idle habits. Some years back we saw annually at Falkirk a lot of West Highland bullocks bred by Mr. Stuart of Harris, and brought by him to that market. They were the best lot of one man's breeding which we ever saw; Mr. Stuart kindly gave us their history. From the day of their birth they had never been under cover; neither they nor their mothers had ever received a scrap of food from the hand of man. In the summer they roamed through the mountain glens. The Atlantic storms throw up on the west of Harris long ranges of sand-hillocks, which become fixed by the roots of a coarse grass, to which, if we remember right, Mr. Stuart gave the name of Bent. We believe it is the same grass which such of our readers as visit Paris may see extensively planted on the railway sides between Boulogne and Abbeville for the purpose of fixing the drifting sands. Mr. Stuart's herd, when driven from the hills by storms and snow, retreated to these sand-hills, and found from them all that they ever received of shelter and food. Both summer and winter they were almost independent of man. The bullocks began their southern travel by a sailing voyage of 60 miles over a very uncertain sea; they then walked about 220 miles to Falkirk, mostly over open moors, on which they bivouacked at night, picking up a living by the wayside as they journeyed. At Falkirk they appeared healthy and lively, fresh as from their native glen, firm in their flesh, and with the bloom of high condition on their long and silky coats. Nor, indeed, were their health, strength, and condition superfluous; for, through the intervention of Mr. Carmichael, or some other eminent Scotch dealer, we believe that their general destination was the Vale of Aylesbury (another walk of nearly 400 miles, for it was before railways were in general use for cattle), where they revelled in the, to them, unwonted luxury of such pastures as are found on the farms of Mr. Senior or Mr. Rowland, and before the day twelvemonth on which they had stood on Falkirk Moor, they had probably all appeared in the shop of Mr. Giblett, or some other West-End butcher. The West Highlander is eminent for the excellence of his flesh; it is not very easy to put on, but when there, it is of first-rate quality and price. This animal does not compete in size with the short-horn or Hereford, but, in the hands of Mr. Stuart, and of the principal Perthshire and Argyleshire breeders, he seems to us to be large enough. About six years ago one bred by Mr. Campbell, of Monzie, obtained the first prize in his class at the Smithfield show, and was sold to a butcher for nearly 50*l.* At the same time the higher and more barren glens furnish the same animal in a smaller compass, and to a gentleman residing in his country mansion he is almost as well worth having for his beauty as for his beef. The West Highlander has one natural defect, which, however, skilful men have much remedied by judicious selection and rejection without tampering with his purity. He has it in common with the wild and with the least cultivated races of his species—with the bison, the buffalo, both of Italy and South Africa, the bullock of Caffraria, and the mountain bull of Spain. The defect is thinness in the thighs and a general falling-off in the hind-quarters. It is a grave agricultural failing. The West Highlander is not very docile, nor very observant of artificial boundaries. His habits of free ranging are not very easily overcome.

Having carried our readers to the Highlands, we must, at the risk of being somewhat episodical, request that on their return south they will accompany us to Falkirk Moor on the second Monday or Tuesday in either September or October. They will there witness a scene to which certainly Great Britain, perhaps even the whole world, does not afford a parallel. On the Monday morning they will see the arrival on this flat and open moor, of flock after flock, to perhaps the average number of 1000 in each, of sheep—some black-faced with horns, some white-faced and polled—the individuals of each flock being, however, remarkably uniform in size and character. They will probably observe that the flocks arrive in pairs, the first being a draft of wethers, and the second of ewes from the same farm. Each flock will be attended by two or three men, and at least as many dogs. They take up their respective stations on the moor without confusion, and stand in perfect quietude in little round clumps, which are separated from each other by only a few yards. The dogs are the main guardians, and though they are generally lying down and licking their travel-worn feet, no unruly animal who breaks the ranks escapes their vigilance, but is instantly recovered. Among the shepherds friendly recognitions are taking place; the hand and the mull are freely offered and accepted, and the news from Ben Nevis, Dunvegan, Brahan, Jura, John o' Groat's and The Lewis is communicated in a singularly soft language, strange to southern ears. We doubt whether we do not much underrate the whole number of sheep thus collected at 100,000. Mr. Paterson, Mr. Sellers, Mr. Kennedy, and Mr. Cameron of Corachoilie will each have several thousands on the ground. We have heard that this last patriarch has 50,000 head of cattle and sheep on his several farms. The greater part of the sheep are in the hands of their respective breeders, though no inconsiderable number have been purchased, without being seen, at the Inverness wool fair, by dealers who are perfectly acquainted with the qualities of every large flock. Soon after the groups have been collected in the manner which we have described, a large number of agricultural-looking gentlemen on horseback and on foot begin to move among them; these are partly southern dealers, but more generally the large turnip-growers from the east coast of Scotland, and from the northern and eastern counties of England. The merits of each flock are so accurately known by those who have an interest in frequenting Falkirk that a cursory inspection suffices. No stranger accustomed to the bustle and the crowd, the handling and the haggling of an English fair, would suspect that transactions of a magnitude to which Barnet, St. Faith's, and Wey Hill afford no parallel, were on the eve of taking place. The owners are seldom with their flocks, but their whereabouts is easily ascertained by those who want them. "What are ye seeking for the Gordon Bush ewes? or for the Invercashley wethers the year?" says the purchaser; and if the parties are well known to each other, a price is named within 1*s.* or perhaps within 6*d.* a-head of what the vendor means to accept. A few words pass about the abatement of the odd shilling or sixpence, and, with a half-jocose complaint that the vender was shabby with his lucky penny last year, several thousand sheep have changed hands. The news of the price at which the best lots are sold spreads through the fair, and, within a very trifling percentage, the value of every other lot is at once ascertained. A large proportion of the lots pass from year to year into the same hands. No purchaser of a smaller number than 500 must expect to get sheep at first hand from any of the standard flocks; indeed, these magnates generally decline to divide their lots at all. On the outskirts of the fair will be found small, mixed, and inferior lots, where the buyer may have haggling for 1*d.* a-head to his heart's content. The settling at Falkirk is as peculiar as the dealing. No man brings money, *i. e.*

currency, with him to Falkirk. On a portion of the moor adjoining the sheep-ground, and adjoining also to long lines of booths, a wooden penthouse about 5 feet square announces itself by exterior placard to be "The Royal Bank of Scotland;" the British Linen Company, the Commercial Bank, and every other banking company north of Tweed appear there also by similar wooden representatives. The purchasers come to the fair provided with letters of credit, and, stepping into the tabernacle to which they are accredited, bring out in large notes the amount required; these are handed to the vender in an adjoining booth, and are probably within a very few minutes at his credit with the issuer or with one of his rivals; for a Scotchman, dealing with a banker who is very reasonable in his charges, and who is to be found in every village in the land, always throws on him the responsibility of keeping his money. The bankers in the aggregate carry from the ground the same notes which they brought in the morning, a few scratches of the pen in their books having sufficed to balance all these large transactions. The clearing of the ground is as orderly as the other proceedings of the day, and, under the superintendence of the best herds and the best dogs in existence, the immense fleecy mass moves off, with almost military precision, on its southern and eastern journey.

What shall we say of the gathering of the morrow? Every isle and holm which opposes its rugged crags to the fury of the Western Ocean between Islay and the Orkneys; every mainland glen from the Mull of Cantyre to Cape Wrath pours in its pigmy droves, shaggy and black, or relieved only, as to colour, by a sprinkling of reds, and of duns graduating from mouse to cream-colour. From Northern and Eastern Sutherland, Caithness, Ross, and Inverness they come in longer on the leg, smooth, and vulgar. From central Argyle, Perth, and from some of the islands, come the carefully-bred West Highlanders; these are the flower of the show, engage every one's talk, and attract every one's attention; every individual of them is a delight to the eye of a connoisseur. Aberdeen and Forfar send in droves of large and bony, but useful, bullocks. A few Ayrshire cows and heifers for the dairy, some miscellaneous lots, and a few Irish, make up the account. We do not know the numbers; we have heard of 30,000, and again of 60,000. The October show is the most imposing. The almost universal colour is black; the moor is in appearance one black mass. You may be accommodated with every size, from that of a Newfoundland dog to a bullock of 100 stones. The cattle are mostly in the hands of dealers, having been bought up at the Northern and Western markets; many, however, of the best West Highlanders are brought to the tryst by their breeders, and you may see a kilted laird from the Hebrides standing, like Rob Roy, at the tails of his own bonny stots and queys. Every dealer in small cattle offers you Skye beasts, and you would be inclined to attribute almost miraculous productive powers to that celebrated island, till you were informed that (as a merchant would say) "that is the favourite brand," and that large numbers of these beasts are brought from the other Hebridean isles to the Skye markets. To speak generally, every one of these animals has his predestined course; the smallest, called six quarters, from being only eighteen months old, will clean up the rough pastures and eat a little straw in Clydesdale, Dumfriesshire, Cumberland, and the neighbouring districts. The older of the small cattle will proceed to Brough Hill, a very favourite fair with dealers, because it is said to be attended by more gentlemen's bailiffs than any other in the United Kingdom. The finest West Highland heifers are for Yorkshire, and the bullocks for the counties of Leicester, Northampton, and Buckingham. The heavy north-eastern bullocks will supply the Lothians with stall-feeders, and will go in large numbers for the same purpose to Northumberland, Lincolnshire, Norfolk, and the south-eastern counties of England. These are all Norfolks when they get to Smithfield market. The proceedings are as orderly, and the dealings on as large a scale, as those of the preceding day. A few small lots of a score each may be found, but generally they run from 50 to 300 and upwards. A purchaser of less than the whole of one of these large lots gets his number, not by a selection, but by a cut: a drover passes through the black mass, and cuts off by estimation the number; they are then counted and made up to the required figure by alternate selections on the part of the buyer and seller. A third day follows, but it is not of much account. The cattle are for the most part miscellaneous lots, and what a Scotchman calls his shots, and an Englishman his culls. We have been somewhat minute in describing these proceedings, because they are on a scale of magnitude quite unknown to Southern agriculturists. We can assure our readers that the men who carry them on are quite equal to the occasion. We always considered our annual intercourse with them to be both a privilege and a pleasure. No trading class can furnish more intelligent men than the Scotch stock-farmers, perhaps, indeed, than the Scotch agriculturists generally; men well educated, of courteous and simple manners, of great intelligence and much general information, enterprising, and keenly alive to every reported improvement. We never could associate with them without drawing rather disagreeable comparisons. Many of these men are originally and still from the Cheviot district of the border; several of them hold stock farms in districts separated by hundreds of miles from each other, besides a more agricultural farm on which they reside. Their system must be excellent, for they only see their mountain farms a very few times in the year. Others hold only one farm and reside on it; and of these, some on the west coast of Sutherland have long been the resident gentry and quasi lairds of the district, though holding under their great superior, the duke of that ilk. Till the very recent introduction of roads and inns, their houses were the only refuge of the traveller from the mountain and moor. We must always have a grateful recollection of a lady who strongly objected to these innovations on her generous and refined hospitality. Though 60 miles from her doctor, and dependent on coasting traders for luxuries and fashions, she looked back with regret to the days when she had no conveyance but a horse or a boat.

Having spoken of the stock-farmer and of the shepherd, we must introduce to our southern readers the third member of the triumvirate, the Dog. To any inquiry of a Scotch shepherd as to the race of one of his faithful ministers, you would receive the answer, "Hout! he is jist a collie." But this designation is far too indiscriminate, for it is applied equally to the malapert animal which, at the sound of your wheels, rushes from every black hut, and, having pursued you for a few score yards with his petulant yaffle, gives his tail a conceited curl and trots back to inform the family that he has driven you off the premises. Far different is the sheep-dog. Whether employed in driving on the road, or herding on the hill, his grave and earnest aspect evinces his full consciousness that important interests are committed to his charge. When on duty he declines civilities, not surlily, for he is essentially a good-tempered beast, but he puts them aside as ill-timed. At an early age the frivolity of puppyism departs from him, and he becomes a sedate character. At home he shares his master's porrich; lies on the best place before the fire; suffers with complacency the caresses of the children, who tug his ears and tail, and twist their little fingers into his long coat; and, without inviting familiarity from a stranger, receives him with dignified courtesy. When accustomed to the road he will, in his master's temporary absence, convey the flock or herd steadily forward, without either overpacing them or suffering any to ramble; and in the bustle of a fair he never becomes unsteady or bewildered. But the hill or moor is his great theatre. There his rare sagacity, his perfect education, and his wonderful accomplishments, are most conspicuous. On the large sheep-farms a single shepherd has the charge of from three to six or more thousand sheep, varying according to the nature of the country and climate. In performing his arduous duties, he has in ordinary seasons no assistance except from his dogs. Those shepherds who have studied political economy introduce the principle of division of labour into their kennels. When on the hill they are usually accompanied by two dogs: of these, one is the driving out, and the other the bringing in dog. To the first he points out a knot of sheep, and informs him by voice, and action, that he wishes them to be taken to a distant hill. The intelligent animal forthwith gathers the sheep together, and acts according to his master's instructions. By similar means he informs the second that a lot of sheep, on a distant hill, are to be brought to the spot on which he then stands; and with equal certainty they are shortly at his feet. To either dog he indicates the individual sheep which he is to catch and hold. The eagerness and impetuosity with which the dog rushes at the neck of his captive would lead you to suppose that the poor animal was in great danger. Nothing of the sort. The dog follows Izaak Walton's precept, and handles him as if he loved him. The hold is only on the wool. The sheep stand in no habitual terror of the dog; though within a few yards of him, the elder will quietly chew the cud, and the younger shake their heads and stamp with their feet, provoking him to frolic, or mimic war. We have spoken here, simply, of the daily occurrences of the sheep-walk—milk for babes—for we fear that the more staggering, but not very ill-authenticated, instances of canine shepherding, with which we might fill our pages, would prove too strong for southern stomachs. Whoever has not read the Collie stories of the great Ettrick herd and bard, has anyhow a rich amusement before him. We love the long face, sharp nose, and sincere countenance of the sheep-dog:—

"His honest, sonsie, baws'nt face
Ay gat him friends in ilka place."

One word of advice to our southern friends who rent Scotch moors for grouse-shooting: keep on good terms with the shepherds. With a little encouragement, a collie dog will find every grouse-nest on the moor. A dinner for the shepherds, with whisky in moderation, followed by tea and a dance for their wives and daughters, are among the cheapest and most effectual modes of moorland gamekeeping. "*Experto crede.*" *

We hardly know how to apologise for this wild digression; but we must recall our thoughts from their wanderings, and return to more homely matters. Having spoken of Short-horns, Devons, Herefords, and Highlanders, we should be unjust if we passed altogether without notice the great improvement which has taken place in the last thirty years in Irish cattle. Though large in amount, it has not been in any uniform direction. As far as we know, there is still neither a race nor a breed of cattle in Ireland. We have heard of Kerry cows, and we know there are cows in Kerry; but, though rather extensively versed in cattle, we have no idea what a Kerry cow is, as distinguished from any other mongrel. The improvement in Irish cattle began, we believe, by the introduction of long-horned bulls from the neighbourhood of Atherstone. The rage for short-horns quickly crossed the Irish Channel, and contributed its share to the general progress. Into the mountain districts there has been a large infusion of Scotch Highlanders. We saw lately a drove of some hundreds of small cattle from the county of Down, of which nearly one-half showed unmistakeably the Highland cross, and a few had a touch of the buffalo. We have been told that a resident Irish nobleman has buffalo milking-cows for domestic use. The general result is, that Ireland now supplies a large quantity of very useful second-rate bullocks to the Leicester and Northampton fairs, and furnishes beef, quite equal in quality to the average of the United Kingdom, to Liverpool, Manchester, and the surrounding district. This comes for the most part in the shape of strong heifers, admirably grazed, and the supply is now continuous through the whole year.

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* We wish that some competent classical authority may be able to assure us that, in the Odyssey, 14th Book, lines 24 and 26, the words "Οἱ δὲ δὴ ἄλλοι," "Οἱ τρεῖς," and "τὸν δὲ τέταρτον" refer to the κυνὲς τέσσαρες which are mentioned only two lines before; and not, as some commentators suppose, to four assistant swineherds, who have not been previously mentioned at all. The latter interpretation receives some colour from the number of portions into which the supper was divided, which favours the idea that the number of Eumæus' assistant herds was four. Still, however, we are inclined to hope and believe that Homer spoke of the dogs. It is curious to find that the ancients were so well aware of the refined education which the canine race are capable of receiving, that the poet could, without comment, represent that Eumæus had sent a dog, *alone*, to take a fat pig from his country station to the city, where, for very good reasons, he was somewhat chary of trusting himself. In the "Υμνος εἰς Ἑρμῆν Apollo's cows were committed to the sole custody of four dogs,

"ἠΰτε φῶτες ὁμόφρονες"—

equivalent to the saying of our South Country hinds, "he's as 'cute as a Christian." We knew an old Whig lord, who, during the long Tory rule, always said of his favourite dog, "He has more sense than any of our ministers."

From cattle we must descend to sheep. The sheep is by nature an animal of the mountain and the wilderness, and the sheep of agriculture is eminently artificial. If we should attempt to reduce the various sorts into races, or even, with one or two exceptions, into breeds, we should find the task far beyond our knowledge and powers. We know that, from time immemorial, a small dingy white sheep, which has had the honour to give a name to the first quality of mutton and of flannel, has existed on the mountains of Wales. Probably these, if any, have a title to the name of Ancient Britons. Very similar were the fleecy inhabitants of the Scotch Highlands till they were superseded, it is said not above 150 years ago, by a black-faced sort from England, which have again been driven from all but their most rugged and inhospitable fastnesses by an incursion of white faces from the border. To the old race, which still exists in Wales, in Orkney, St. Kilda, and in the parks of some Highland lairds, the Portland sheep seems to bear a close affinity. In the hands of persevering Scotchmen, the black-faces have attained a consistency and an uniformity which does not exist in England; the old Norfolk is their nearest English representative. The Cheviots, also, have much improved by their migration to the north; they have also acquired considerable consistency, and we doubt whether it has been judicious to tamper with it by the introduction of Leicester blood. A white-faced horned sheep, which inhabits a moorland district called the Derbyshire Woodlands, the old Cambridgeshire, and a Dorsetshire sheep, bear to each other a marked resemblance. The Southdown, far the most comely of our English sheep, has about him several of the characteristics of an old race. But how gat he without his horns? In agriculture the Southdowns are invaluable. Grazing the shortest and driest pastures—bearing, from their hardihood and from the closeness of their fleece, confinement on a claggy lair, either in the turnip-field or in the fold, better than any of their congeners—they are not only of more general utility to the mixed farmer, but they also yield a supply of mutton considerably above the average in quality. The black-faced Shropshire ewe is a vulgarised Southdown, which has acquired size and has lost quality. We hear that a big Cotswold sheep is studying refinement, and trying to force himself into favour. But of all the polled and white-faced sorts, the New Leicester, though he may of late have somewhat declined in favour, remains still far the most important. With no pretensions to be a race, they have become, beyond all dispute, a very distinct breed. The New Leicester tup, in his best form, has a smart head, is long and low, with a tabular back, with wide rumps, "thick," as graziers say, "through the heart of him," with wonderfully covered sides and shoulders, but very inferior to the Southdown in his legs of mutton. The colliers in the north say that "a little fat mutton makes a many fat potatoes." To furnish that mutton is the vocation of the New Leicester, and he performs it worthily. He is mutton food for the million; and sincerely we hope that, in his present or in some improved form, he will be brought year by year more within their reach. With some deductions, analogous to those which we urged in the case of the short-horn, we must admit his superiority over his competitors in this particular, that he yields at the least cost, and in the shortest time, the largest weight of meat. There our eulogium must end. His flesh is coarse, his wool is inferior, his constitution is tender. Obesity of body and serenity of mind act and re-act on each other, and have conspired to make a Leicester tup a marvel of idleness. He is equally difficult to provoke to love or war: he dies soft under hardships. Showmen find it to be their interest to place together a giant and a dwarf—the extremes of the human race. In order to exhibit at one view the extremes of the "genus ovinum," with a Leicester ram, prepared for the show, should be coupled a Welsh ewe from Cader Idris, fresh from the hill, newly shorn, and having just weaned her lamb. We throw out the hint to Mr. Burgess or Mr. Stone.

If the sheep of agriculture is an indefinite animal, the agricultural pig is still more so. Every tyro in breeding has tried his hand on them. Every gentleman farmer presents his friend with "a gilt of my own breed." "Encourage the breed of pigs," said the Bishop of Chester (now of London) to his clergy, if credit is to be placed in the metrical version of his lordship's Charge, indited by the Rev. Sydney Smith. We hope that what was enjoined on a parson is not forbidden to a reviewer, for we have had our experience in pig-breeding. We inherited a long-legged sow, hog-backed, bristly-maned, flat-sided, slouch-eared, rather a ferocious-looking animal. Twice a year she was followed down the lane by an almost interminable series of little grunters—reduplications of mamma—sixteen, eighteen, we believe even twenty at a litter. But how could these satisfy the eye of a critic? So we began afresh, and a few years of judicious selection and crossing gave us animals of almost perfect symmetry. The litters, however, from far in the teens, dwindled to six, four, and at length our favourite sow produced one. Nor was this all. The roaded bacon three inches thick, for which, when trimmed with beans, we have seen gastronomes of undoubted authority desert farther-fetched dainties, was replaced on our table by six inches of rather flabby fat, unredeemed by lean. So when we could not even save our bacon we gave up the pursuit; and we are inclined to think that our experience was a sort of epitome of high breeding. A snub-nosed race, called Chinese pigs, or Tunks, have some distinctive marks. They may, for what we know, claim an antiquity coeval with the Shee-king and Shoo-king, though, indeed, we are not precisely aware of the authority on which they are said to have come from "the Flowery Land." They are funny little fellows; pert and queer in their ways; very symmetrical; poor breeders, and not exactly the pigs to furnish contract bacon. The Neapolitan, the Portuguese, and the Berkshire pigs have many points in common. For a constant supply of pleasing pigs we should select the Lisbon market. They are the only cleanly animals of a domestic nature (we make no exceptions) in Portugal; very uniform, very symmetrical when fat, and of sufficient activity to get their living in the chestnut-woods during the early part of their lives. To this feeding we should have attributed the delicacy of their pork, if we had not heard, on good authority, that in America mast-fed bacon is very inferior both in firmness and quality to that which is fed on grain. Whether the animal which, by an agreeable alliteration, is called a Hampshire Hog owes any of the celebrity of his bacon to acorns and beech-nuts we will not pronounce. We are inclined to attribute a good deal to careful and scientific curing. Pigs, both in their natural and domestic state, deteriorate if exposed to cold. We are told that the wild boars of Barbary, Bengal, and Scinde are much finer animals than those which endure the severity of a northern winter in the forests of Germany. Nature made the pig an animal of great activity and spirit. Man, in the due exercise of the power which has been conferred upon him of moulding nature to his own convenience, has made him a creature of flitches and hams. We think, however, that, in the case of the pig, the transforming power has been exercised rather wantonly. Of all the overloaded animals which deform our cattle-shows, none so entirely outrages delicacy as the *improved* pig. Unless his legs shrink under the weight of his shapeless carcass; unless his belly trails on the ground; and unless his eyes are quite closed up by fat, he has no chance of a prize. The extremes of domestic swine are Prince Albert's prize pig at the one end, and the pig whose domestic hearth is in the hut of the Finn, all the way from St. Petersburg to Archangel, at the other. This latter is an animal of skin and bone. From his looks you would not suppose that he has any vitals: there seems to be no room for them. His bristles, if not his ornament, are at least his distinction. He furnishes them to our markets to an extent both in quantity and value which, but for custom-house statistics, would be thought fabulous, and to which we only reconcile our judgment by recollecting that he appears, by these his representatives, on the toilet-table of every lady, we might almost say of every female, in Great Britain. As to flesh, if one could conceive such an animal to be ever subject to the tender passion, the epithalamium with which Porson honoured the union of the lean master of Benet with a leaner bride would be highly applicable to him:—

> "Though you could not, like Adam, have gallantly said,
> 'Thou art flesh of my flesh,' for flesh ye had none,
> You at least might have said, 'Thou art bone of my bone.'"

Such are the extremes. "*Medio tutissimus ibis.*"

But in swinecraft we are pigmies when compared with the ancients. Ulysses, at one swine-station in Ithaca (and we are told that he had others on the mainland), which was under the care of Eumæus, had 600 breeding sows. They were lodged in twelve stately chambers (fifty in a chamber), built of quarried stone, and adequately furnished with yards, fenced in by a substantial paling. The male pigs (πολλὸν παῦροτεροι) were only 360. This disproportion of numbers is accounted for by a statement of the insatiable voracity of the "godless suitors." So much for swine. On the subject of turkeys, geese, fowls, rabbits, and "such small deer," we must refer our readers to the "Book of the Farm." Be it noted, however (though not mentioned in this new *Stephani Thesaurus*), that the prime turkeys of East Anglia, whom we apologize for classing among "small deer," are *capons*. This is true at least of the huge Goliahs, the glories of Guildhall, one of which an astonished Paddy pronounced "fit to draw a gig."

In comparing the merits of the various agricultural animals which furnish food to man, we have frequently spoken of quality, and we wish to explain a little more definitely what we intend thereby. We consider firmness in the fat and a fine grain in the lean to be the criteria of quality. We believe that in those animals where fat and lean are associated, the firmest fat invariably covers the finest-grained lean. Any person who has had the good fortune to eat Highland venison with fat on it will have observed that the fat of a stag differs from that of a Lincolnshire tup much as heart-of-oak differs from the wood of a Weymouth pine or poplar. The wild deer's fat is a substance of firm texture, hardly degradable, we should think, into dips or short sixes. The fat of the fallow-deer possesses much of the same enviable quality. When we descend from the forest and the park to the pasture and stall, we can form a series both for sheep and beasts which will hardly be called in question. For sheep—the Mountaineers, the Southdowns, various nondescripts, down to the New Leicesters. For beasts—Scots generally, Devons, Herefords, indiscriminate crosses and mongrels, down to the Improved Short-horns. In each case the butchers' shops will confirm our lists. There the animal which stands at the top will sell for at least 1*d*. per lb. more than the animal which stands at the bottom. In both cases, in the article of quality, the new and very artificial breeds stand decidedly below all their competitors. To them must be awarded the merit of producing a coarse article in great abundance and at a low price, suited to those whose appetites are keen and not critical, and whose means are limited; whereas the old races will furnish an article of higher quality for those whose tastes incline, and whose means permit, them to be more fastidious. Whether any individual farmer shall produce one article or the other must be left to his own decision; and, if wise, he will decide the point on the same grounds of position, facilities, and connexion which determine a cotton-spinner to make forties cotton-twist, or to make one-hundred-and-sixties; and which determine a calico-printer to manufacture prints for ladies, or prints for housemaids.

Our readers will have observed further that in all these lucubrations we have made a marked distinction between races and breeds, and we wished to state the basis on which that distinction rests. Of late years certain sages have brought prominently before the public a science to which, in the prevailing rage for a Greek nomenclature, they have given the name of Ethnology. This science occupies itself in investigating the localization, the affinities, and the distinctive qualities of the various races of men. It is a circumstance which we would rather call satisfactory than singular, that the observations made and the facts collected —made and collected with true philosophic indifference as to the conclusion to which they might tend—all lead to the belief that mankind have sprung from one original pair. At this conclusion, on grounds merely philosophical, Cuvier and Humboldt have both arrived. We call the conclusion satisfactory, because it may re-assure some very worthy people, who discountenance philosophical investigations because they entertain narrow-minded apprehensions that revelation will not be able to take care of itself. As men multiplied, their different families were placed in different circumstances of climate, soil, food, security, and demands for exertion, both mental and bodily. These external circumstances produced modifications both in the form and capacities of their bodies, and in the qualities and capacity of their minds. When successive generations had been so long subjected to the same influences that these modifications had become so far engrafted and permanent, that they were found in all the individuals who remained under the influences, and would endure for long periods even in those who were removed from them, a distinct race of men had been called into existence. Two familiar illustrations of this permanence will occur to every one: the Jew, though by ethnologists he would only be considered as one subdivision of an important race, is said to have maintained his national physiognomy in all the various circumstances in which the Dispersion has placed him: and we know that the Negro, when not contaminated by white blood, retains his woolly hair, his thick lips, his long heel, and his mental incapacities, though he has been transplanted for generations from the banks of the Tchadda to those of the Mississippi. To any investigation into races of animals the aid of language is wanting altogether: history also is more silent, and tradition more obscure, than in the case of man. Still considerable materials remain to those who may be inclined to pursue an interesting inquiry, for which we have neither leisure nor knowledge. Even zoologists, who seldom pretend to have much respect for the Mosaic records, seem, on the whole, inclined to an orthodox conclusion—to wit, that animals came as individual pairs from the hands of the Creator. This opinion is favoured, it must be owned, by operations of nature of which unphilosophical people are daily witnesses. Nature permits the connexion of many animals and birds, which have considerable apparent similarity, to be productive of offspring, but refuses to carry fertility further. The horse breeds with the ass, the dog with the fox, the pheasant with the domestic fowl, the goldfinch with the canary; but all the offspring are sterile. On the other hand, the buffalo breeds with the short-horn, the dray-horse with the Shetland pony, the deer-hound with the poodle, the Dartford-fowl with the bantam, the Caucasian with the Bushman; and all the offspring are fruitful. And yet the outward dissimilarity is greater in the individuals forming the respective pairs in the latter series than in the former. Is it an unnatural hypothesis, then, that, in all cases in which the offspring of a connexion is fruitful, the father and mother are both descended from one original pair? We think not; but for our immediate purpose—and it is a practical one—it is sufficient that we should feel assured that the same influences of climate, soil, security, ease, or hardship, which have exercised so permanent an effect on man, have also formed different races from animals originally of the same type.

To come to our own case of cattle—where we find much uniformity of size and shape, a self-colour, and a similarity of disposition and aspect, recurring generation after generation, and even remaining after the external circumstances of the animal have been materially changed, we have reason to conclude that these distinctive marks have been produced by natural causes; in short, that Nature without the interference of man has produced a race of cattle: and further, we shall be confirmed if we find that this race does not require the assistance of man to preserve it from deterioration. Should history, ancient painting or sculpture, or even reasonable tradition, give evidence that animals, having the same distinctive marks, existed at a remote period, our conclusion will have received still further confirmation. On the other hand, we witness daily the immense power which man possesses of modifying the various animals which he has reduced to domesticity. Sir John Sebright bred pigeons to a feather; and thirty years ago we were used to see here and there dairies of sheet cows, which some very fanciful gentleman had called into existence. But these artificial animals had a constant tendency to relapse, and to lose those coveted distinctions which the sedulous care of man had impressed upon them. Still by patient and judicious perseverance a breeder of cattle may produce considerable uniformity, and impress distinctive characters and qualities on the animals which he calls into existence; and by dint of liberal rejections may maintain the distinction for a lengthened period. When he has done so he may be fairly said to have created, for all agricultural purposes, a new breed of cattle; and in this sense Collins (perhaps), and Bakewell (certainly), may be said to have respectively created a breed of cattle and of sheep. But these breeds never have become, and probably never would become, races. We have abundant evidence that their distinctive qualities can only be maintained by the sedulous care of man. When Devons, or Herefords, are transplanted from the banks of the Exe, and the Wye, to those of the Hawkesbury, their offspring continue to be Devons and Herefords. But the short-horn, under similar circumstances, resolves himself into his elements; and distinct traces of all the mongrels out of which he was concocted re-appear within a few generations. In Midland dairies short-horns have nearly supplanted all other breeds. No one can move among them without observing how very inferior they now are to what they were ten years ago. When they came from the north they had all the merits which belong to the breed. Under the ordinary care of the dairy-farmer they have deteriorated rapidly. Several large farmers have appealed to the north again, and have procured bulls of undoubted blood (whose dams and sires were No. this, that, and the other, in the herd-book), without producing any very satisfactory results. We doubt whether improvement is to be found within the limits of the herd-book; our faith is, that, when an artificial breed has been created by crossing, it can only be maintained by crossing. We looked lately through stalls containing 50 short-horned cows in course of preparation for the Birmingham meat-market. Wherever one appeared somewhat better than her neighbours, the invariable explanation was, "She has a good cross in her." When Bakewell died he left on his farm a good flock of sheep, perhaps for their purposes the best in the kingdom. His successor imagined that a breed had been created which could perpetuate itself and its merits; but, under that system, and in his hands, the flock came to a melancholy end—size, constitution, fertility, flesh, wool—all gone; nothing but a little tallow left. The successor of this gentleman was a Derbyshire man; and he brought with him on to the farm a good flock of sheep. They had in them a good deal of Bakewellian blood; but when their owner saw them dwindle, he had recourse to a large roughish ram from the limestone district of his native county: a big-headed, big-boned, big-muscled animal;—

> "omnia magna,
> Pes etiam."

Under such management this flock, of which we have now lost sight, for a long time retained its celebrity.

We have appealed to self-colour as one characteristic of a race of cattle. We have done so partly because, with few exceptions, quadrupeds in a state of nature are self-coloured; and we are not aware of any wild animal whose colours are patchy or glaring. The British wild cattle, as preserved in the parks at Chillingham, Cadzow, Chartley, and Lyme, are of a dingy white, with tawny ears. The cattle of mountainous countries, which have been very inaccessible to agriculture, are always of self-colours—black, red, or dun. The Caffrarian cattle are black. The queer little cow which, within the memory of man, had a pure existence in Normandy and the Channel Islands, and which, being celebrated for the richness of its milk, came to our markets under the name of an Alderney, was fawn-colour, with tawny ears. So-called Alderneys are still brought to those vicinities in which gentlemen's seats abound; but by crossing they have lost their uniform colour, and some of their other characteristics. The voice of antiquity indicates self-coloured cattle. The bulls which Nestor sacrificed on the strand at Pylos were παμμέλανες. The bull which escaped Mercury, when at three days old he started on a foray to drive Apollo's cows, was κυάνεος, probably black; but, whatever were the exact shades, certainly self-coloured. The bull, over whose sacrificed carcass the oath of the Ἑπτὰ ἐπὶ Θῆβαις was sworn, was black. Indeed the only instance which occurs to us, in which party-coloured cattle are alluded to by any classical author, is the line in which Virgil declares his own toleration of motley:—

> "Nec mihi displiceat maculis insignis et albo;"

and this very expression seems to indicate the prevalence of self-colours, and that the variety which he mentions was not in very general favour. Then comes the *vexata quæstio* of horns. Wide-horned and lofty-horned are constant epithets applied to cattle in the Greek authors. It always appeared to us that, in a claim for antiquity of race, any animal who came into court without horns exhibited a *primâ facie* case against himself. On the other hand, a gentleman, who is as enthusiastic as ourselves about Scotch cattle, but who, while we prefer the Highlander, fixes his affections on the graceful Galloway, always maintains that horns raise a presumption of a bar sinister in the escutcheon, and considers our horned cattle as the offspring of what Mr. Thomas Moore calls "a museum of wittols." The Hereford brings good evidence that he is the British representative of a widely-diffused and ancient race. The most uniform drove of oxen which we ever saw consisted of 500 from the Ukraine. They had white faces, upward horns, and tawny bodies. Placed in Hereford, Leicester, or Northampton market, they would have puzzled the graziers as to the land of their nativity; but no one would have hesitated to pronounce that they were rough Herefords. The splendid cream-coloured ox of Lombardy is a Hereford in form. You might dye him into a Hereford, but all the dappling in the world would not make him into a short-horn. So much for modern affinities. There are hints also from antiquity. The calf "*fronte niveus videri, cætera fulvus*," must have been a Hereford. According to the description in a fragment of Bion, the bull which ferried Europa across the sea from Crete was so complete a Hereford, that he might have come from the herd of Mr. Price or Sir F. Lawley. We are gratified by these evidences of permanence. A few years ago we had some apprehension that, under the influence of fashion and favour, the democratic insurrection of the breeds would have swept away the races. We knew the origin of the breeds; they had been loosely put together under our own eyes. Nothing in their career satisfied us that we knew accurately what was to come. Our aspiration was for something standard. We did not think that what Horace Walpole called the union of "nobody's son with everybody's daughter" was a satisfactory basis on which to found the supply of cattle for a great beef and mutton eating nation. Now the tide has turned. The new breeds have manifestly declined in popular favour. They will no doubt still occupy the position which may be due to their ascertained utility. The current of authoritative decision has also turned. It did for many years run in favour of the new breeds: now the balance is the other way. At every important exhibition the highest prizes have of late been carried off by the races. As good Conservatives, we rejoice at this, for they are the Bovine aristocracy, and we wish to see them maintain their position in society. If we should seem to our readers to have spoken with too little favour of those enterprising and persevering men who originated our new breeds, and have carried them to their present point of excellence, we beg at least to disclaim all sympathy with those scoffers who represent the breeders and the bred as being much on a par in intellect—

"Strong as his ox, and ignorant as strong."

In our estimation, no man ever became an eminent breeder without possessing many very valuable mental qualities—the power of accurately observing matters both important and minute, and of appreciating their value—judgment and decision—perseverance—and another quality still more valuable than these, self-reliance.

Having travelled so far with our mute companions, we must say a few words on their more immediate preparation for the final stage in their career.

Of cattle made fat on natural pasture little need be said. No doubt a grazier, to be successful, must exercise considerable judgment in the selection of animals, and must discern with an experienced eye when his land is stocked to the exact point at which it will give the greatest produce. We have heard it said of one old gentleman, that he could tell when there was half a bullock too much or too little in one of his hundred-acre fields. A very small proportion of the grass land in England will, unassisted, turn out animals of the degree of fatness which is required by modern customers, and a still smaller proportion in other countries. Such lands, however, do exist about Boston and other fen-land vicinities in Yorkshire and Lincolnshire; sparingly on the alluvial borders of some of our principal rivers, and in the vales of Belvoir, Aylesbury, and Evesham. Equal, perhaps, to any of these, and far above their average, are the splendid upland pastures which are found in Burton, Great Bowden, and other townships in Leicestershire (many of which our fox-hunting friends overlook, with an enthusiasm not purely agricultural, from Carlton Clump near Kibworth Beauchamp), in Braybrooke and Fawsley in Northamptonshire, and in Lidlington and another township, of which we forget the name, in Rutland. Nor must we omit the celebrated hundred-acre field at Cestus Over, of which local tradition sayeth, that, on a fine showery day in May, the farmer laid down his stick on a bare spot, and, being hastily summoned home by his dinner-bell, left the stick behind him. After his dinner he smoked only one pipe, and, returning straight to the field, was unable to find the stick, which, having in the interval been smothered by the growing grass, was only discovered when the pasture was eaten bare in the succeeding winter.

The history of the grazing lands in the Midland Counties is singular. For no other district has nature done so much, and industry and science so little. A generation, with which many of us who are still in a green old age have had personal intercourse, saw these upland pastures in a state of ploughed common fields, the enormous ridges having been produced by many centuries of ploughing, the furrow being always turned upwards. These ridges still remain (and he is a good hunter who skims them cleverly), very frequently describing an easy double curve. When inclosed, and devoted to pasture, these lands were not sown with artificial grasses, but were left to acquire the turf with which it pleased Nature to clothe them. For forty or fifty years they improved progressively. From that time they have been stationary, at least, if not retrogressive. Except a little, and generally very imperfect, soughing,* they have received no improvement. Lord Gardner and Mr. Little Gilmour fly over the same ox-fence now, which was charged of yore by The Meynell, Lindo, and Germaine. Some graziers, to be sure, have diminished the size of their fields by subdividing, and some have increased it by grubbing up fences, and no doubt such spirited men were, in this British Bœotia, considered to be improving farmers. But "*adhuc sub judice lis est.*" The real improvements in agriculture passed these men by, or were brought to their doors without exertion on their parts:—take as an instance the improvement of cattle, and the improved mode of conveying them to market. They had a monopoly, and the sluggishness which attends monopolies. But John Bull will never submit to be stinted in his beef.

To avoid, however, all disagreeable points—somehow land of a quality which would graze cattle had become inconveniently scarce, in proportion to the demands of John's increasing family; and thus stimulated, his ingenuity has found a substitute in an immense extension of artificial feeding. Our ancestors had an ample supply of beef from August to November. By dint of lattermaths and a little hay, a few beasts were kept on, rather in a stationary than in an improving condition, till the cold weather had fairly set in; then they were slaughtered, and by pickling and salting dry (nothing exists now on which Mr. Moore could found his joke, "hung beef, my Lord, if you try it") furnished beef for the winter and spring. A stalled ox was a luxury, and a rare one. We believe we need not go far back to the period when the Midland Counties did not furnish a single systematic stall-feeder. By most farmers the process was considered to be ruinous. Artificial green food is now grown on land of every description. The tables have been turned on the mere grazier. The mixed farmer overwhelms him with numbers, with weight, and with fatness. We have daily under our eye lands, now united into one farm, which bring to market annually 250 beasts, averaging about 100 Smithfield stones each, and a still larger number of fat sheep. Within thirty years those lands supplied about a score of the former, of about two-thirds the above-named individual weight, and only a few score of the latter. On two somewhat smaller and neighbouring farms the change has been still greater, and in the same direction. The mere grazing-farms have receded in value more than any other lands in Britain. Men of capital, occupying largely in the Lothians, Northumberland, Yorkshire, Lincolnshire, and Norfolk, have improved their systems, have stood their ground, and have many of them been blessed with prosperity. Those who live in the vicinity know the melancholy list of Leicestershire and Northamptonshire graziers who, starting with undoubted capital, and carrying on business on a large scale, have occupied as their fathers occupied before them, and, with no fault but that of belonging to a stationary system, have been overwhelmed; have disappeared from the scene; having commenced with property and ended with debt. Our remarks apply with increased force to the second and third-rate grazing-lands of the Midland District. A few years ago we should have looked for the least improved district of agricultural England from the top of Robin a-tiptoes, on the confines of Rutland, Leicester, and Northampton. No prospect could, in an agricultural point of view, be more melancholy. Large spongy pasture fields, so encumbered with vast ant-hillocks that nothing but an accomplished hunter could gallop among them with safety, bounded by rambling fences—land of considerable power and inconsiderable produce. "I went by the field of the slothful; and, lo, it was all grown over with thorns, and nettles had covered the face thereof, and the fence thereof was broken down. Then I saw and considered it well: I looked upon it, and received instruction."*

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* An old Midland county term for Under-draining.—EDITOR.

The stall-feeding of cattle is no modern invention, though, as a general agricultural practice, it may almost be said to be new in England. The "stalled ox" is cited as a luxury in the Book of Proverbs. The difference between stall-fed and grass-fed oxen is marked in the daily consumption of Solomon's household—"Ten fat oxen, and twenty oxen out of the pastures." But though stall-feeding is now general as well as ancient, no agricultural practice has proved a more fruitful occasion of controversy. Cooked food and raw food, warm food and cold food; open yards, open sheds, and close cattle-houses; tying by the neck and turning loose in boxes: each of these practices has its enthusiastic and unhesitating advocates. So also as to the description of food. The object is admitted—the greatest produce at the least cost. One man would be ruined but for gorse; another cannot dispense with hay; a third declares hay to be superfluous, and that the object may be attained by the "corpus vile" of straw. So in roots: mangold-wurzel has its enthusiastic advocates, and equally so parsnips, carrots white and red, cabbage, and swede turnips respectively. And, again, in the cerealia and their congeners; men of nice observation discriminate between the beneficial effects of each: some by chemical analysis; some by the Baconian process of induction; and the result is that meals of every description—barley neat and barley malted, grains, linseed, oil and oil-cake—are accepted and rejected with most perplexing confusion. We really wonder that those who feed by book do not throw up the case in despair. We should be as unwilling to decide these points on the conflicting testimony of the correspondents of agricultural journals as we should to give a verdict on the evidence of Irish witnesses. The controversies will generally be best settled by a reference to local facilities. Gorse is good—where you have poor and congenial land and ready access to a water-wheel or steam-engine to crush it effectually. Grains are good—where you are near a large brewery and can buy them at or under *4d.* per bushel. Hay is good—where you have meadows which are effectually manured by some river or stream; and you may, or perhaps you must, make straw an article of diet to your feeding-cattle, where hay would cost you *3l.* per ton. We believe that *10s.* per ton would more than balance the feeding-value of any two sorts of meal. Where a stall-feeder has on his premises the means of grinding or crushing, there can be no doubt as to the economy of consuming by his cattle any sort of unmarketable corn. Where he is distant from a mill it may be economy to give it whole. We do not think that the controversy between barley and malt is ripe for decision. As to roots: if you are so fortunate as to occupy a deep dry loam, you may grow parsnips or carrots, or anything else short of tropical exotics; but beware of them on the sharp gravels or shallow sands, from which, by a plentiful application of manure, you may coax an ample crop of turnips, and may feel yourself much at your ease as to the mode of using them, as you may draw them off, or consume them on the land, in all weathers. On land which, however well drained, has an inclination to be sticky, you must make up your mind to have more trouble with your green crops; but if used tenderly, it will give you a heavy weight of mangold-wurzel, turnips, or cabbage. They should, however, be sown early, for you will have no comfort with them if they remain on the land after November.

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* We are told by a resident that something in the way of improvement has been done near Robin a-tiptoes, and that much remains to be done.

So we dispose of all articles in general use for cattle-feeding—except *oil-cake*. It is amenable to no local facilities, and is just as applicable to one situation as to another. In spite of repeated denunciations it maintains its ground. The popular tradition respecting it is singular. For many years linseed-crushers threw what they considered as the refuse of the mill to the manure-heap. A cottager's lane-fed cow, having access to one of these heaps, was observed to be frequently feeding at it; and she gave evidence by the sleekness of her coat and the increased fulness of the pail that the food was highly beneficial. So it came into use, and was soon found to produce fat as no article had ever produced it before. Veterans of our standing will remember the denunciation of cake-fed beef. It had an unnatural taste—the shambles where it prevailed had an unnatural smell—the grain was coarse—the fat was liquid or rancid—the meat would not keep—and so forth. *Now* Mr. Giblett or Mr. Slater gives 6*d*. per Smithfield stone extra for a Norfolk-fed Scot (the animal of all in the market which has eat the most oil-cake), simply because they dare not send any other sort of beef to the nobility and gentry who are their customers. No other article of food (except perhaps bean-meal, which has the disadvantage of making the flesh hard) gives to a butcher the same full confidence that the dead weight of an animal will be fully equal to his appearance when alive. All the prejudices against this food were founded on the three letters O I L. Persons who are prejudiced neither investigate nor reason, or they would have discovered that linseed-cake consists of the husks and farinaceous parts of linseed from which all the oil has been expressed by most powerful machinery; and that though the quantity of oil expressed from a given quantity of seed has been constantly on the increase in consequence of improvements in the machinery, there has been no corresponding, nor indeed any, decrease in the fat-producing properties of the cake. A more refined investigation would have informed them that a ton of cake contains less oil than a ton of any sort of grain. The same delusion which appalled the consumers delighted the producers of beef. They fancied that it was about to lead them to an important discovery. They argued, not illogically—"If the remains of oil in this article of cake have such great feeding properties, how vast must they be before any oil has been expressed from it!"

Forty years ago we saw at Bretby, under the charge of Mr. Blackie, and at Swarkestone Lowes, then occupied by Mr. Smith, the earliest systematic stall-feeder in the midland counties, considerably extensive preparations for crushing, and steaming, and steeping linseed. Some other feeders went a step further, and said, "If oil adulterated with husks, &c., is so feeding, how much more feeding must oil unadulterated be!" and they gave the oil neat. But all the parties soon relinquished such practice. The result did not bear out the *à priori* reasoning. The beasts so fed never got very fat, and the fat they had was very loose and oleaginous. Experience soon showed that neither linseed nor oil could be used with advantage until they were let down by a very large admixture of chopped straw or of some other low qualitied matter. On this experience the recently-renewed practice of feeding with linseed (of which Mr. Warnes is the apostle) is founded. We give the account of the preparation in his own words:—"One pailful of linseed-meal to eight of water." This makes a jelly. "A large tub being conveniently placed, a bushel of pea-straw or turnip-tops cut into chaff is put in; two or three hand-cupsful of the jelly are poured in," stirred up, &c. "Another bushel of the turnip-tops, chaff, &c., is next added;" and so on till the tub is full. And besides this, when Mr. Warnes begins to have a near view of the butcher, he adds "barley or pea-meal to the mixture." The prejudices against cake are now exploded. It has a fair hearing, and stands or falls on its merits. No doubt it is expensive food; but it is so effective, so clean, so easily stored, and so much less liable to pilfering than any sort of meal, that we expect to see it stand its ground.

When farmers have determined on the description of food, how are they to give it?—hot or cold? cooked or raw? We have seen an argument as follows (we have not space to extract the passage, but we will state the argument fairly):—A certain sustained temperature of body is necessary to the health and growth of every animal. Liebig has shown that this animal heat is produced and sustained by combustion—oxygen inhaled into the lungs burns carbon which it finds in the blood—if it does not find carbon enough in the blood it seizes on the carbon which exists in the fat, and if there be no fat then on the carbon in the muscle of the body. Food supplies the carbon to the blood, and through the blood to the fat and muscle. If you introduce a quantity of cold food into the stomach of an animal you lower the temperature of its body. The first duty of the food so introduced will be to furnish as much carbon for combustion as will restore the normal heat, and the residue only can be applied to making fat and muscle. If you give warm food, the quantity required for the above purpose will be smaller, and the residue applicable to fat and muscle will be larger. Therefore there is a waste of food in giving it cold. We detect no flaw in this reasoning: but a sort of instinct founded on long experience always prompts us to look out for practical qualifications of abstract reasoning. We were just preparing to say to the reasoner—"Before we can consent to found our practice on your argument, you must prove to us that burning the extra food in the body is not the cheapest way of restoring the heat destroyed. Charge yourself with the very considerable outlay requisite for warming the food —with the fuel—with the labour and waste: take into account that, when you have heated your food, it will cool very rapidly while it is before the beasts; that it will cool very rapidly while it is being divided into portions; that any which is left must be heated over again." We were just going to say, "When you have taken all this into the reckoning, tell us the result," when we stumbled on the following passage in an account of the Cattle Lodge at Howick:—"The opinion of the feeder is, that the animals did not thrive so well on steamed straw as when it was given naturally. We believe that, with the exception of linseed—if, according to Mr. Warnes' experiment, that is an exception—it will not be found that the cooking food for cattle, even if it be beneficial, will repay the extra cost," &c. Remembering that Mr. Warnes has been the great advocate for warm and cooked food, we turned back to his experiment, and we find as follows:—Eight Scots shut up in October: four fed "on the cold linseed mucilage;" "the other four have had boiled linseed." "His own opinion, and that of many other farmers who have seen the animals, is, that the four fed on raw linseed are superior to their competitors." Mr. Warnes says, "But admitting the fattening properties of both systems to be equal, the cold must possess the greater advantages—1st, because firing is dispensed with," &c. And again, "So satisfied has Mr. Warnes become of the superiority of the cold linseed, that he means at once to adopt it in the feeding of the rest of his cattle." It is somewhat singular that we have made the whole of these extracts from the same publication, in which we had previously found the Liebigian argument, which we have abstracted, put forward as conclusive. Year by year prizes have been offered to agricultural machine makers for the best apparatus for preparing warm and cooked food for cattle. Many feeders have within our knowledge gone to a great expense in putting up such an apparatus. Every one of them has, we believe, discontinued its use. Nothing is so contemptible as to sneer at unsuccessful experimentalists. Truly our very best hopes for agriculture are founded on the entire explosion of the spirit which used to prevail at our farmers' market-tables in this respect. The reasonable experimentalist is now looked up to as a general benefactor. The patriotism of those who, having the means, make promising experiments, either in agriculture or in anything else, without a view to their own personal advantage, takes a very rational line. Every one knows and regrets that many discoveries, made by ingenious men in the spirited prosecution of commercial enterprise; though they have proved to be of great national advantage, have failed to realize a profit to the inventors, and have in some unfortunate cases resulted in their ruin. We are inclined to believe that the experiment of giving warm and cooked food to cattle has failed.

We have already adverted to the very ambiguous sounds emitted by the oracles when consulted on the subject of the lodging of cattle. Our own experience, in a moderately-sheltered situation, is, that beasts do best in open sheds well flanked, but open to the S. or S. E. The Norfolk man is prodigal of his straw, and his beasts come out beautifully clean. The Midland and Western man is perforce more economical, and the same cleanliness is hardly to be attained. We know an instance in which cows lie habitually without litter, and are decently clean. Their hind legs stand on a strong flag (the produce of the district, probably of the farm), and behind them is a flagged trench fourteen inches wide and three deep. In twelve years no injury has occurred to the cattle from this trench. At regular intervals holes of an inch diameter are drilled through the flag in the bottom of the trench, and communicate with a drain. The more solid matters are removed with the least possible labour, by means of a shovel which exactly fits the trench. The fore parts of the animals lie on the natural ground. The feeding beasts are as prone to recumbency as in any well-littered stalls, and, except on the east coast, we have seldom seen a cleaner cow-house. The arrangement for bullocks is more complicated, involving the necessity of a drain covered by a bored flag or grating into the middle of each stall. We are bound to admit that the tails, to the great injury of their cleanliness, are apt to slip into the trench when the animals lie down. We wish we could suggest a remedy short of docking that ornamental member. On this farm the proportion of arable land is very small, and every straw is cut up for cattle keep. The cow-house which we have described is a great favourite of ours, because it solves a difficulty which very much perplexes every improving Midland and Western farmer, namely, scarcity of litter. We are inclined to think that the sphere within which this difficulty is felt is extending; the tendency of modern agriculture being to longer courses, and to a less frequent recurrence of straw-giving crops. The real vocation of straw on farms having a large proportion of grass-land, if not on all others, is to give bulk to more nutritive articles of cattle keep. When it is cut up and properly sugared, cattle will eat it to the stumps. Box-feeding is a recent practice, and highly commended. It must involve a liberal use of straw or other litter. The idea that the animal should be confined for months in a loose box, from which nothing is removed, is not very comfortable; but the practice is connected with the consideration of the injury which manure may suffer by exposure to the weather. We know one spirited experimentalist who has gone to a very material expense in roofing, in order that he may have the whole of his manure under cover until it is laid on the land. This is a strange innovation on the practice which prescribed repeated heapings and turnings before the manure was brought into use. Some years ago we read in an agricultural journal, that to mix up a large quantity of snow with a heap of manure was highly beneficial, and philosophical reasons, which we have forgotten, were given for the practice. Should the doctrine of a dry lair now prevail, the liquid-manure tanks will be deprived of their principal source of supply.

Till very lately flesh-meat in general, and beef in particular, had its seasons of plenty and low price, succeeded by scarcity and high price, just as regularly as summer and autumn are succeeded by winter and spring. The extremes were from August to December, when naturally-fed beasts poured into the market, and from February to June, when those which were fed artificially came in by driblets. Those who have watched the markets for the few last years will have observed, first a tendency to equalization, and then to a complete turning of the tables, which has been fully developed in the season now in progress. The first-named period gave, in the year 1848, to Smithfield, for the Monday's market, from 2000 or 2500 bullocks, with a price for the first quality from 3*s*. 10*d*. to 4*s*. 4*d*. per stone. The second period, now in progress in 1849, is giving from 3200 to 3600 bullocks, with a price for the first quality from 3*s*. 4*d*. to 3*s*. 8*d*. Nor do these figures represent the full difference of the supply of meat, because there can be no doubt that a larger amount of dead meat comes in by railway in the cold months than in the warm. This is a great revolution, which we have no doubt will be in some degree counteracted by an increased prevalence of artificial feeding in summer, either as auxiliary to grass-feeding, or as independent of it.

We have now brought to a close the principal remarks which have occurred to us as bearing on that vocation of the occupier of land, in pursuance of which he furnishes a supply of animal food to his country. We take leave of our cattle-loving friends, and we hope they will not think us less friendly to them because we have omitted any prominent mention of the distressing position in which we and they are placed by the unprecedentedly low price of this article of agricultural produce. Whatever measures they may consider it incumbent on them to take with reference to protection or to taxation, general or local, we think it must be wise to keep these matters quite distinct from the question of the most efficient practice. We cannot look around us and doubt that, in order to maintain our position, to the most efficient practice we must resort; and if our remarks can assist any struggling farmer in discovering and adopting it, we shall have attained our object.

We had hoped to have included in this article some remarks on draining, a subject so intimately connected with artificial feeding that it may almost be called its foundation. But time and space forbid. A few memoranda which we had made must be returned to our desk, perhaps to be re-produced on some future occasion.

AGRICULTURAL DRAINAGE.

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PREFACE TO SECOND EDITION.

PROBABLY many of the persons who will see this Preface, are aware that I contributed to the "Quarterly Review" an article on Agricultural Drainage, which appeared in its 171st Number, and which, in the year 1850, was reprinted by Mr. Murray in a separate form. Mr. Murray has now requested that I will revise this reprint for a second edition. It would be troublesome to divest the thing of its reviewing form; but as it has become a treatise, I think that I may drop with advantage the critical spirit. I have therefore struck out several passages having reference to controversial writings, which it is no longer necessary to keep before the public; I have woven into the treatise a few matters which further experience and observation have brought to my notice; but the main principles and arguments remain as they were. I have increased confidence in them. Since the article was first written I have continued to employ in draining from 15 to 20 men both winter and summer. A drain made in summer is, in the article of excavation, generally somewhat more costly than the same work executed in winter; but it is less liable to injury from slips, or to interruption from bad weather. The carting of materials is also less troublesome in summer, and the work is generally executed in a cleaner and more perfect manner. I am partial to summer draining when it can be done without unreasonable interference with crops. Several of my neighbours carry on drainage perseveringly on the system which I have endeavoured to explain; and I believe that, without an exception, they coincide with me in opinion as to its beneficial effects. I have had the opportunity of watching for more than three years the operation of 4-feet drains 9 yards apart on 40 acres of the stiffest clay which I ever saw in any county, absolute clay to the surface without any covering of soil. This draining was not executed by me, nor does the land belong to me. I could wish any agriculturist, who doubts the efficacy of deep drains in clay soils, to see this land, and to converse with its present owner; who, some years ago, before it was drained, abandoned its cultivation in despair. I doubt whether any water has either remained on or ran off its surface since it was drained. It forms part of the disafforested forest of Needwood, and is in the parish of Tatenhill, county of Stafford. I have seen it stated in an agricultural publication, that deep drainers have been compelled to diminish the intervals between their drains with which they originally commenced. This has not been the case with me, nor with any other deep drainer with whom I am acquainted. I began with 9-yard intervals, and now use 12 on similar land, and am satisfied with the result. I put my draining to a severe test. I invariably abolish the ditches in the fields which I have drained, and never admit a grip, or water furrow. For autumn sown crops, wheat, vetches, or beans, I always give the last furrow across the slope of the land. In short, I throw every possible impediment in the way of the superficial discharge of water. I believe that, with the exception of one or two hours during the deluge which burst the Holmfirth Reservoir, and which was general over the Midland Counties, no water has run from the surface of my drained lands for the last three years, and none stands on them an hour after rain has ceased. I think that these facts are sufficient proof of the efficiency of the draining. Lord Wharncliffe has proposed a herring-bone system of draining, consisting of a somewhat deep main drain running in the line of steepest descent, into which discharge a series of parallel shallow drains, drawn across the slope of the land. His Lordship gives a general adhesion to the doctrine, that steepest descent is the true line of drainage. I do not therefore see why his shallow drains are not placed in that direction. Nor does his Lordship profess any confidence in the shallow system; but recommends it on the score of economy. I think that Mr. Parkes, in a small publication entitled "Fallacies, &c.," has shown that his Lordship's system, taken as a whole, is not entitled to that recommendation. Were I to adopt his Lordship's system, I must abandon, 1st, the principle of depth, and 2nd, the principle of direction; and if I abandoned those two principles, I had much better put this treatise into the fire than send it to Mr. Murray for republication.

I trust that my readers will have the kindness to impute the egotism which pervades this Preface to a sincere conviction on my part that I have derived more advantage from the statements which practical men have kindly given to the public of the results of their own operations, than from any other sort of agricultural reading.

T. GISBORNE.

Yoxall Lodge, April 10, 1852.

AGRICULTURAL DRAINAGE.*

PINDAR bequeathed to us the maxim "Ἄριστον μὲν ὕδωρ," to which the Portuguese have added the equally pithy proverb, "Water is wealth." The present state, the early history, and the ancient remains of eastern and southern countries concur in informing us, that the first and most successful efforts of agriculture were directed to an artificial supply of water to the various objects of cultivation. The special promise made to the Israelites was, "The land, whither thou goest in to possess it, is not as the land of Egypt, where thou sowedst thy seed, and wateredst it with thy foot, as a garden of herbs: but the land whither thou goest is a land of hills and valleys, and drinketh water of the rain of heaven." And so our northern and sea-girt isle drinketh the rain of heaven to repletion; "*immensum cœlo ruit agmen aquarum.*" We do not span our valleys with aqueducts, and rib the sides of our hills with superficial courses, to convey adventitious water to our agriculture. On the contrary, we invoke ingenuity to devise, and science and labour to execute, subterranean conduits to relieve our cultivated lands from the excess of water which they receive from the skies. When the agricultural interest congregates for the purpose of mutual condolence or congratulation, their pattern men never fail to declare that draining is the foundation of agricultural improvement—and that if there be salvation for them, it is to be found in draining. Every here and there a booby exists who says, " How can you expect grass to grow if you take the water away from it? How in a dry summer?" But he is overwhelmed at once by the rush of the agricultural mind in an opposite direction. Through the length and breadth of the land a crusade has been preached against water. Pipes and collars are the devices of this national movement. This is " the piping time of peace." We have put our necks into the collar, have taken suit and service, and have sworn allegiance to this cause. We find ourselves associated with a very motley crew, who are brought together indeed by some unity of object, which they not only seek to attain by various and incongruous means, but carry on a fierce internal controversy, in which every disputant accuses the plan of his opponent of failure, and boasts largely of his own success. We will endeavour to impart to our readers the conclusions on which, after some experience, a close observation of the works of those who claim to be authorities in this matter, and a painful and ill-requited attention to the literary and oratorical war which is raging around us, we have determined to base our own practice.

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* 1. "Journal of the Royal Agricultural Society." Vol. IX., Art. XI., "On the Failure of Deep Draining," &c. By Wm. Bullock Webster. London, 1848.

2. "Mechi's Experience in Drainage," &c. Third Edition. London, 1848.

3. "Essays on the Philosophy and Art of Land Drainage." By Josiah Parkes, C.E. London, 1848. Longman and Co.

But before we take a prospective view of our craft, we must glance at its early history, and at the various steps and stages by which it has arrived at its present position. Though the ancients for the most part courted water as an ally to their agriculture, they did not hesitate in many cases to encounter it with great energy and perseverance as its enemy. They were not slow to perceive the extraordinary vegetative capacity of those amphibious lands, which are deposited by large rivers within the debateable margin of two elements, of which their agricultural poet says,

> "Huc summis liquuntur rupibus amnes
> Felicemque trahunt limum."

Any person disposed to acquire, at a small expense of time and trouble, a general knowledge of the war which men of old carried on with the marsh and the fen, may consult the first two-and-thirty columns of the great work entitled, "The History of Embanking and Drayning of divers Fens and Marshes, both in Foreign Parts and in this Kingdom; extracted from Records, Manuscripts, and other authentic Testimonies by William Dugdale, Esq., Norroy King of Arms." This indefatigable man, though a very voluminous writer, scorns any superfluous exordium, and commences his book and the history of antediluvian draining by the following sentence:—"That works of draining are most ancient and of divine institution we have the testimony of Holy Scripture." After a passing notice of the draining of the earth on the subsidence of the Deluge, he proceeds to say, "That those nations which be of greatest antiquity, and of chief renown for arts and civility, are also famous for their works of this nature, is evident from the practice of the Egyptians, the Babylonians, the Græcians, the Romans, and several others of which I shall give instance." In pursuance of this purpose our author furnishes us with a detail of various works of draining, embankments, and outfalls commenced in Egypt shortly after the Flood, and carried on to the Christian era. Among the illustrious promoters of the art he names Mysis, Sesostris, Sabacon, Psammeticus, Necos, Psammis, Bocchoris, Darius, Amasis, Alexander, the Ptolemies, Cleopatra, and Augustus Cæsar. He takes a somewhat discursive view of a navigable channel from the Nile to the Red Sea, which was commenced by Sesostris before the Trojan war, and, after several futile attempts by succeeding princes, was completed by a Ptolemy. The various routes by which the traffic of

Europe passed to the Indies do not escape his observation; and he settles the track of Solomon's voyage from Eloth to Ophir. For this varied information he cites, among his authorities, the sacred books of Exodus, Kings, and Chronicles, and appeals to the secular testimony of Herodotus, Theocritus, Strabo, Diodorus Siculus, Josephus, and Eusebius. Having thus happily dispatched Egypt, our author proceeds to Babylon. We learn, on the authority of Herodotus, Pliny, and Strabo, that the drainages of Belus and Gobaris were effected by improved outfalls, whereas their female successors in the art, Semiramis and Nitocris, worked by embankments. Nor are we left ignorant that it was Sir Walter Raleigh's opinion that the reason why "there is so little written of Belus, who succeeded Nimrod as the first Assyrian monarch, is that he spent much of his time in disburthening the low lands of Babylon, and drying and making firm grounds of all those great fens and overflown marshes which adjoined to it." Passing into Greece, our author, who never rashly rejects the miracles of a heathen god or of a popish saint, holds an even hand between Thessalian tradition, which imputes the draining of the lake Bæbeis to Neptune, and the opinion of Herodotus, which inclines to an earthquake; "but," says he, "no man can deny it to be a very remarkable work of draining, or that it is now a place of extraordinary pleasantness." Unless our schoolboy recollections deceive us, either some "Musa Etonensis" or old Latin poet says,—

> "Ut ferus Alcides Acheloia cornua rupit,
> Dum petit amplexus, Deianeira, tuos."

We now learn, with reference we suppose to this story, that Achelois roared as a river, and not as a bull, and that the mythical horn broken off by Hercules was one of the river's devious courses; for "they which collect truth out of fables say that Hercules, who was generally beneficial, for Œneus his father-in-law's sake, restrained the exorbitant overflowings of the river with banks and trenches, and drained a great part of the adjacent country; and that this was the cornucopia which the poets made to be the emblem of plenty." We will not drag our readers through the Pompeian Marshes, the Fossa Mariana, or the Fucine Lake. Suffice it to say, that the alternate reclamations and re-floodings of these and other Italian swamps are faithfully recorded from the consulate of L. A. Gallus and M. C. Cethegus unto the reign of Theodoricus. For all this we have the usual medley of authorities, commencing with Livy, Pliny, and minor Latin annalists, and ending with the Odyssey, the Iter ad Brundusium, and some inscriptions from a temple at Terracina. We are reminded, moreover, that a Roman consul, who had reduced his provinces to a state of tranquillity, was ordered by the senate, "*ne in otio militem haberent*," to employ his legions in winning lands from the sea on the coast of Latium; "neither is the employment thought too mean for the legions, though consisting of freemen:" a very natural reflection for Norroy King of Arms, being himself a practical drainer, and which he specially commends to the notice of the authorities at the Horse Guards.

For the drainages in the Belgic region our author claims no higher antiquity than A.D. 863. He assures us on the authority of Kilianus, "the learned Euredius," Sermundus, and the edicts of the Pistensian synod, that, in 863, Baldwin the First, son-in-law of the Emperor Charles the Bald, commenced the works about Bruges. These works appear to have endured till the year 1169, when—a breach having occurred, "the which the Flemings could by no means fill up, neither with wood, nor any other matter, for that all sunk as in a gulf without any bottom"—by agreement between Floris, earl of Holland, and Philip, earl of Flanders, a thousand men, expert in making of dykes, were sent to stop the breach: "who being come to the place, they found a great hole near unto this dam, and at the entrance thereof a sea-dog, that, for six days together, did nothing but cry and howl very terribly. They, not knowing what it might signify, resolved to cast this dog into that hole; whereupon a mad-headed Hollander, getting into the bottom of the dyke, took the dog by the tail, and cast him into the midst of the gulf, with earth and turf after him; so as, finding a bottom, they filled it up, by little and little." Hence the name Hondtsdam and the dog, in the armorial bearings of the town of Dam.

"I now descend to Holland and Zealand," whence he proceeds to Friesland, Holstein, and Mexico. But we spare our readers even an enumeration of the authors, commencing with "P. Bertius de Aggeribus," and ending with "Pierius Winsemius de rebus Frisicis" and "the learned Schoneveldeus," who are cited by this man of singular research in support of scraps of history, quasi-geological deductions, moral reflections, and queer anecdotes. At length we are fairly landed on the sea-board of Kent, and find the history of English embanking and draining given, after our author's peculiar fashion, in 832 folio columns. We have waded through them; and hardly know whether to exhibit this feat to our readers as an example or as a warning. We will endeavour to impart to such of them as have not trod the path before us, a general idea of the ore and of the dross which this mine contains; leaving to their own taste the decision whether they will work it further. But we must premise that even those who are acquainted with the "Monasticon" cannot read this work without marvelling at the extraordinary industry of the man, and at the strange objects to which it was applied. He devours public records and other documents, which represented Blue Books in his day, with all the voracity, and digests them with more than the accuracy, of our Joseph Hume. He revels in dates, measurements, and prices. He affects no originality, and indulges in little disquisition. He ransacks all literature, the most standard and the most obscure, for anything which, by a liberal construction, can be considered analogous to his subject. From an epic poem to a catalogue, nothing comes amiss to him. The result is, that the work of which we speak has no more to do with the *philosophy* of embanking than of billiards, nor more with the *art* of draining than of music. To be sure, in the former case, the words which recur from time to time are marsh-banks, fen-dikes, weirs, and dams, not cushions, cannons, and hazards; and in the latter, sluices, gates, spouts, and clows, not flats, sharps, and semitones. But beyond a familiarity with these terms a student of Dugdale will learn nothing either of the philosophy or of the art. Three thousand five hundred names of persons, and nearly five thousand names of places, are the staple of the work. It may interest some of our readers to know that Thomsons, Dicksons, and Jacksons had not yet appeared on the scene; whereas Sweteblodes, Thunders, and Forshames have perhaps now departed from it. The name of every person who sat on a commission of sewers from the time of the third Henry to that of the second James is recorded, as well as the name of every plaintiff and defendant in a marsh-land suit, and of every place immediately or remotely connected with these litigations. When A sues B. for having failed to repair a dyke or scour a sluice, the plea, the answer, the replication, the rejoinder, the evidence, the adjournments, the rehearings, and the verdict. are given with the utmost minuteness. Probably a diligent student might extract from this work a digest of marsh-land law, and show how, from time to time, it was advanced and settled. Then we have a record of every session of sewers and assembly of jurats through twenty-one reigns, and a full account, or more frequently a copy, of each of their *proprio motus* and presentments. These sometimes produce curious matter, as in the following instance:—

"In 6 Edward II. the jury for the hundred of Cornylo exhibited a presentment unto Hervic de Stantone and his fellow-justices itinerants, imparting that the Prior of

Christchurch in Canterbury did, about ten years then past, divert the course of a certain water, called Gestling, in which such felons as were condemned to death within the said hundred ought to suffer judgment by drowning; so that by this turning of that stream, those condemned persons could not there be drowned as formerly; and that this was to the prejudice of the King. . . . . The Sheriff, therefore, had command that he should cause the said gutter to be put into the same condition as it was before; and the said Prior was amerced."

A fair sample of these documents, which run through hundreds of columns, we take at random from a presentment of the jurors at a session of Sewers in 13 Elizabeth:—

"15. That Mil-lane, from Tholomer's drove, and reaching from the crest in Mampasse to the pipe in the drove, be made in height 4 feet, and in breadth 8 feet, by the Dean of Ely and Lord Berkley.

"16. That the lands between Sorrel Dyke and Belly-mill Dyke do make Sorrell Dyke and Belly-mill Dyke in height 6 feet and breadth 8 feet."

This presentment, of which we have copied the 15th and 16th articles as being among the shortest, runs on to No. 120. Somewhat more interesting is a detailed account of the early efforts of Francis and William, Earl of Bedford, to improve the great level, for which they and their participants received 95,000 acres of land.*

Being in the neighbourhood of Thorney, we will here allude to a singular statement with reference to that lordship which we find in a tract printed in 1629, and entitled, "The Drayner Confirmed, and the Obstinate Fenman Confuted:"—

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* A work, in two thick quarto volumes, published in 1830, by Mr. Wells, registrar of the Bedford Level Corporation, gives a full account, historical, legal, practical, and statistical, of the drainage of the Great Level of the Fens. The account is as minute as Dugdale's, with less entertaining gossip, but no doubt possesses great local interest.

"At Thorney Abbey my Lord of Bedford lets between three and four hundred acres of rising ground upon which the abbey stands, for 300*l.* per annum, whereas the rest of his Lordship of Thorney, containing sixteen or seventeen thousand acres of drownd ground, is esteemed and now lyeth of little or no value. Yet it appeareth by the historie of William of Malmesbury (vouched by Mr. Camden), who lived about twelve hundred years since,* that in his time it represented a very paradice; for that in pleasure and delight it resembleth heaven itself; in the verie marishes bearing trees that for their straight tallnesse, and the same without knotts, strive to touch the starres. A plaine there is as even as the sea, which with greene grass allureth the eye; so smooth and level that, if any walke along the fields, they shall find nothing to stumble at. There is not the least parcel of ground that lyes waste and void there. Here you shall find the earth rising for apple trees, there you shall have a field set with vines, which either creep upon the ground or mount on high upon poles to support them, for in those days vineyards were very frequent in England."

Perhaps the Fenland vineyards are as figurative as other portions of this description, but there is no reason to doubt that the latter end of many portions of the Fens was worse than the first. In accordance with the above recital are the facts largely stated by Dugdale, and confirmed by subsequent observations, of submerged forests of the finest trees, whose roots are fixed in solid earth many feet below the present drowned surface of the fen, with other evidences of pristine fertility. On the other hand, "large rudders done over with pitch, as also anchors, barge nails, and other naval instruments," found many feet below the now solid ground at Eye in Suffolk, give evidence that that place was, as its name imports, formerly an island. Such metamorphoses are appropriately noticed by Ovid in a passage beginning—

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* That would be about A.D. 420. No doubt the meaning is in the twelfth century. William of Malmesbury is supposed to have been born about 1050.

> "Vidi ego quod fuerat quondam solidissima tellus
> Esse fretum, vidi factas ex æquore terras"—

and they are largely spoken of by Amm. Marcellinus and other ancient writers. Dugdale and his predecessors impute these changes to earthquakes, between which opinion and the modern theory of alternate subsidence and elevation, we must leave the Dean of York to decide.

The legal details in Dugdale's work are infinitely tedious. Still they present several points worthy of observation, and give evidence of an equal administration of justice in very early times of our history. We find, almost invariably, a performance of its public duties enforced on property, and local jobbing repressed with a firm hand. Our author, rejecting the Britons as barbarous, and the Saxons as illiterate, fixes on the Romans as the first who recovered lands by banking out the sea in England, fortifying himself by a fanciful interpretation of a passage in "the famous Tacitus, an author of that time." On the authority of monastic records he declares a marsh-land common law, administered by twenty-four elective jurats, to have been in existence A.D. 796, and to have been then designated in "unquestionable documents," as "*antiquas et approbatus consuetudines.*" The most important power of the jurats was that of levying a rate, and distraining for non-payment, for which distress, in case of imminent common danger, there was no replevy, "*quia necessitas defensionis talis inopinata, si venerit, legi communi vel justitiæ subesse non poterit.*" But in 35th Hen. III., the sheriff of Kent, on a threatened irruption of the sea into Romney Marsh, replevied the distresses. The king instantly issued his writ and letters patent restraining the sheriff, and, in consequence of "the controversies risen between the jurats and the marshmen," he sent down "Henry de Batho, a famous justice itinerant of that time, to hear and determine them."

He framed on this occasion ordinances which settled the "laws and customs of Romney Marsh," and are frequently referred to in royal commissions and Acts of Parliament as "the famous ordinances of Henry de Batho." "They have been long ago made the rule and standard whereunto all the other marshes and fens in this nation were to conform." Romney Marsh is the subject of the first chapter on English affairs. We recommend it as a fair sample of our author's matter and manner. It will be interesting to most readers, though probably the majority will not wish to pursue the subject further.

The monastic orders were large landowners in all the English fens, from which circumstance our author is led to favour us with a considerable amount of legendary lore. We are informed that "Ethelreda, called vulgarly Audrey," and subsequently St. Audrey, performed numerous miracles, and founded a religious house of nuns in Ely, of which she became abbess. To us, among the most marvellous of her miracles are, that, having been married to "Tombert, a prince of the Southern Gyrvii or fenmen, at his death she retired into the Isle of Ely, a pure virgin, notwithstanding she was his wife almost three years:" "that about five years from the beginning of such her retirement, Egfrid, king of Northumberland, being highly inflamed with her beauty, obtained her for his wife;" and, finally, that "after she had been wedded about twelve years, she, without any free leave of her said husband, as a queen and a virgin repaired to the monastery in Coldingham in Scotland." It is perhaps less surprising that, when at the close of one year King Egfrid desired to have her domestic society again, she, by a series of miracles very analogous to those performed by Moses in the wilderness, resisted all his attempts to recover her. In like manner "St. Guthlach, a devout hermit," founded the abbey of Crowland, where, before "that devout servant of Christ, no countryman could endure to dwell by reason of apparitions of devils which were frequently seen there;"

and that these apparitions were formidable we are assured by a description of them as they appeared to Guthlach in his cell—"black troops of unclean spirits which crept in under the door, as also at chinks and holes, and coming in both out of the sky and from the earth, filled the air, as it were, with dark clouds. In their looks they were cruel, and of form terrible, having great heads, long necks, lean faces, pale countenances, grisly beards, rough ears, wrinkled foreheads, fierce eyes, foul mouths, teeth like horses', spitting fire out of their throats, crooked jaws, broad lips, loud voices, burnt hair, great cheeks, high breasts, rugged thighs, bunched knees, bended legs, swollen ancles, preposterous feet, open mouths, and hoarse cries,"—a particularity of description which might suffice for a Russian passport, or for the *Hue and Cry*.

We are next favoured with the authentic anecdote and original rhymes about King Cnut and the sweet singing of the "Monckes in Ely." Then, many columns are occupied by the assault of William the Conqueror on the Isle of Ely—his futile attempts to carry the position by means of a witch—the prodigious feats of Hereward the Saxon—and the final conquest, after a seven years' siege, in consequence of the treachery of an abbot. The narrative of the Fenland insurrection in the time of the Commonwealth, which was headed by the notorious Lieutenant-Colonel John Lilburne, "a person," says Dugdale, "of a most turbulent spirit, and who since died a quaker," though abundantly garrulous, is somewhat more in the tone of sober history. Cornelius Vermuden, a native of the Low Countries, contracted with Charles I. to recover a large extent of drowned fen, over which certain royal rights extended, on conditions by which all existing rights appear to have been fairly compensated. Under this contract Vermuden and his participants recovered 74,000 acres of previously worthless fen so effectually, that the average crops of wheat on it were three and a half quarters per acre, oats eight quarters, "and for six years together seven quarters of oats on one acre." Vermuden and Co. received their stipulated remuneration in the shape of 24,500 acres of the reclaimed land. On this they built a town called Sandtoft, erected a church, and introduced as settlers 200 families of Walloon and French refugee Protestants. For eighteen years they held quiet possession. According to Dugdale's representation, Lilburne gathered round him three classes of malcontents: 1st, those patriots to whom a royal grant under the great seal was an unjustifiable exercise of prerogative; 2ndly, the jealous John Bull, to whom the vicinity of a foreigner and a Frenchman was an offence; and 3rdly, the unreclaimed man,* who, even in civilized societies, lingers on the margin of the waste and of the fen. These parties, "taking advantage of the present distractions," broke down the sea-banks, let the water in on the houses, crops, and cattle, and destroyed works which had cost 200,000*l.* in the erection. They seized by force the property, which they did not destroy, and Lilburne appropriated to himself the parsonage house at Sandtoft (using the church as a barn) and several thousand acres of land. When the injured parties attempted to obtain redress by law, Lilburne, by his influence with the Parliament, the army, and the magistrates, parried their efforts for eleven years; and though they at length got a decree of the Council of State in their favour, the nature of the case rendered it impossible that they should receive any adequate redress.

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* All writers on marsh-land affairs afford abundant evidence of the existence and of the turbulence of this class. In James I.'s time, they adopted a new mode of warfare, "by bringing of turbulent suits in law, and making of libellous songs to disparage the work," of which kind I have here thought fit to insert one, called "The Powtes Complaint,"—a dozen stanzas, of which probably a couple will suffice for our readers:—

"They 'll sow both beans and oats where never man yet thought it,
Where men did row in boats, ere undertakers bought it:
For they do mean all fens to drain, and waters overmaster,
All will be dry, and we must die, 'cause Essex calves want pasture.

"Wherefore let us entreat our ancient water nurses
To shew their power so great, as t' help to drain their purses;
And send us good old Captain Flood to lead us out to battle,
Then two-penny Jack, with scales on 's back, will drive out all their cattle."

We knew a clergyman of the old school who complained vehemently when a marsh was drained in the vicinity of his parsonage. He said it had been worth several pounds a year to him in pike and wild ducks. Our reverend friend was a most expert snarer of woodcocks. A neighbouring squire gave him a quarter of beef every Christmas on condition that he should not set springes on his estate.

Here we must close our notice of this singular work: a laborious structure framed on a model which is assuredly little suited to the habits of modern writers, and as little to the fastidious tastes of modern readers. Yet it was highly esteemed by our ancestors. It has been several times reprinted, and we learn from the preface to an edition which was published in 1772, that ten guineas was the sum "at which this work, when it can be met with on sale, which rarely happens, is sold." It still holds a place in our libraries, and the copies which come into the market are freely bought at the price of some guineas. In the edition of 1772 the spelling has been modernized, and the black letter, in which names of persons and places was originally printed, discontinued.

If Dugdale had not detained us so long we would willingly have given our readers an abstract of the Tract entitled "The Drayner Confirmed." It was printed in the year 1629, and again in London, 1647. It is anonymous, and from certain similarity of style and expression, we should, but for its practical tendency, be inclined to attribute it to Sir Wm. Dugdale. It contains some curious Fenland history, and enumerates eight Acts of Parliament, between the 9th Hen. III. and 12th Edw. IV., all passed with a view to the improvement of the fens. But the main object of the writer is to incite his own countrymen to a general measure for the drainage of the fens in Lincolnshire and five adjoining counties. He undertakes to show: 1st, that it would be honourable to the King and profitable to the Commonwealth; 2ndly, that it is feasible; and 3rdly, how a competent reward may be apportioned for them that should undertake so great a work. He adverts to the fact that some "overthwart neighbours" (the Hollanders, to wit) had proposed to drain our fens on condition of receiving one-third part of the land recovered. Against this project the author argues with stubborn patriotism, and shows the absurdity of our allowing foreigners to "empty themselves" into our marshes, while we are sending our own countrymen into Ireland, Bermuda, &c. Still he is not wholly destitute of cosmopolitan feelings, as evinced by the declaration, "neither yet would I be understood to bee so envious to strangers, as that I had rather the water than they should possesse the land." The whole treatise is quaint, clever, and entertaining. We have endeavoured in vain to obtain a printed copy. That which we have (by the favour of a friend) is in manuscript.

In addition to the two volumes by Mr. Wells to which we have referred, we possess much valuable literature on the subject of Fenland drainage in voluminous reports to Parliament, in the works of Rennie and Telford, and in the "Transactions of the Institution of Civil Engineers." We cannot at the moment refer to any printed evidence of Mr. Tycho Wing's services to the cause, but we know that no man has laboured more assiduously to diffuse useful knowledge among Fenmen, and to incite them to scientific practice. Many publications, both ancient and modern, have reference to the state of Holland, Zealand, Sleswick, and Holstein, and to the creation of territory in those extraordinary countries. The never-ceasing resistance which is there carried on against a devouring element is of the highest interest, both historical and scientific. This subject, however, we pass by the more willingly, because a very able article expressly devoted to it in the 174th No. of the "Edinburgh Review," leaves little to be supplied or desired. The student of Fenland literature will observe two instances of the slow manner in which great projects ripen, though, when founded on a correct appreciation of man's ability to add to his power or enjoyment, they seldom fail to recur to his mind in due season. In the very commencement of the seventeenth century Cornelius Vermuden and the author of the "Drayner Confirmed," pointed out the methods of draining Whittlesea Mere and the adjoining country, almost as they are enacted in the statute of 1844, and strongly recommended their execution. In like manner, in 1640, Adrian Leeghwater proposed to drain the Sea of Haerlem by means which, with the substitution of wind for steam power, are analogous to those which are now in course of employment.

Some years ago a Grand Ducal work was published in Florence, giving a history of the operations carried on by that persevering family in the Tuscan Maremma. The work consists of a thick octavo volume, accompanied by a thin quarto of plates and statistics, the whole got up in superior style. The general engineering appears to be good, and plans are given of the principal bridges, locks, and weirs, as well as drawings of the tip-waggons, piledrivers, and other engines. The object of the operation appears to have been, in part at least, sanitary. Tables are given of the population at different eras in the Maremma, with notices of the proportion of sick admitted into the Royal hospitals, previous and subsequent to the drainage. The whole work is interesting both as it relates to the recovery of land and the increase of salubrity.

So much for the first phase of the controversy between agriculture and water. It may rather be called the recovery of land than its improvement—absolutely so in the cases where large surfaces of water have been replaced by cultivated land, and partially, to say the least, in the more ambiguous cases of what old Dugdale calls overflown marshes, where the contest has been settled in favour of dryness and solidity. Our readers will observe that we have not entered into the process of recovery—that has not been our object; but we have wished to give them a succinct account of the existing literature on the subject, and to indicate to such as are interested where they may find treatises, historical, legal, scientific, and practical, on an art, which, on the present occasion at least, we do not propose to teach.

Two other cases remain in which water appears as an opponent of agriculture. The first is that in which rain, falling on pervious lands, and filtered through them much to their benefit, reappears in the shape of springs on the surface of lower lands not equally pervious, much to their injury. The second is the case of lands which, from closeness of texture, are not able to pass down the rain which falls upon them, and can only get rid of the portion which the plants growing on them do not consume, by superficial discharge or by evaporation. The combat with these two cases marks two distinct eras in the history and progress of draining. The first enemy the Romans encountered manfully, as was their wont. Their remedies were, open and covered drains from three to four feet deep, the latter being half filled with small stones or very clean gravel previous to the return of the earth. In the absence of stones and gravel, " sarmentis, vel stramine subjecto cooperiantur, vel quibuscunque virgultis," branches, straw, or any kind of twigs. They fortified every important outlet with stone-work or other masonry. For non-filtration on tenacious lands they appear to have had no other remedy than clean furrows, water-gripping and open cuts running across the slope of the hill. Their sensibility to the evil of surface-water is shown by the many and minute directions for getting rid of it, which are given by all their agricultural writers—Cato, Varro, Columella, Virgil, Pliny, and Palladius. This whole matter is ably treated by Mr. Dickson, in his fifteenth and sixteenth chapters of " Husbandry of the Ancients," where the reader will find an ample reference to all the authorities.

The earliest notice of English draining which we have discovered, is contained in a broadside in vol. iv. of the Collection of Proclamations, &c., once belonging to James II., now in the library of the Society of Antiquaries, London;

"Herein," says the writer, who dates from Paine's End, the 16th of Nov., 1583, "is taught even for the capacity of the meanest, how to drain moores, and all other wet grounds or bogges, and lay them dry for ever." The draining for wet grounds is of a shallow order, and is illustrated by a herring-bone pattern. The main drain is to be filled with stones; but our capacity is certainly too mean to understand how an open course for the water is to be maintained in the lateral drains, or "slope draynera," as the writer calls them. The directions for executing them are as follows:—"Dig them one foote deepe at the least, and one foote broade in the bottome, and not above two inches broade at the top, so will the top close up againe and the bottome will be hollow,"—"so shall you lose no ground. The charges for ten acres is 26*s.* 8*d.*, besides carriages, which charges, the earth which you cart out of the ditch and drayners, being wel spred, wil countervail for the manuring of the ground." The directions "To draine Bogs" contain all we know at the present day, or nearly so, with the exception of the use of the boring-rod.

Our researches into agricultural literature have brought us acquainted with Walter Blith, "a Lover of Ingenuity," and Andrew Yarranton. Like other writers on husbandry, both published at a time of great agricultural depression. The former, about 1640, in "The English Improver," "discovered to the kingdome that some land, both arable and pasture, may be advanced double or treble," other five or ten, some twenty fold, &c. &c. The latter, in 1677, in "England's Improvement by Sea and Land," taught his countrymen to "outdo the Dutch without fighting, to pay debts without moneys, to set at work all the poor of England with the growth of our own land," and many other things. We have but a few words with him, for, though he does not entirely overlook draining, he says nothing on it to our purpose. His grand remedies are—1st. To lower the rate of interest to landowners by means of a registry of deeds. This, according to him, would enable them to take a certificate of registry to the Bank of England, or to Overend and Gurney's, and to discount it at 3 per cent. So much for landlords. 2nd. For tenants he has public granaries, in which they are to deposit their corn, and to receive for it corn-notes; these will pass from hand to hand "actually equal to cash," which, consequently, can never be scarce. 3rd. Manufactures are to be encouraged by a strict monopoly of the home market. He concludes thus:—"If any gentleman, or other, please to put pen to paper, in opposition to what is here asserted, I shall give him a civil return, bound up with the second part, where these seven heads shall be treated on"—two will suffice:—

"3rdly. Demonstrate and make it appear how Ireland may be brought to twenty years' purchase, and made as useful to England, and of as great strength, as Norway is to Denmark."

"6thly. How to employ six thousand young lawyers and three thousand priests for the good of the public and mankind."

This second part we have unfortunately been unable to discover. We beg pardon for digression, but we could not wholly pass by remedies so admirably suited to our own wants and times.

Our copy of the first edition of Walter Blith's book is without date, but it was evidently published before Charles and the House of Lords were set aside, for in the title-page it speaks of the "Kingdome," and it is addressed to the two Houses of Parliament. A large type, a wide margin, and a liberal incorporation of Tusser's Rhymes, only extend the work to the modest size of 168 pages. But in 1652 matters are much changed. "Walter Blith, a Lover of Ingenuity," has became Captain Walter Blith. The word "Kingdome" is dropped out of the title-page. The "third impression, much augmented," is dedicated to "The Right Honourable the Lord Generall Cromwell." The author's ideas, as well as his book, have evidently expanded at the rapid rate then in fashion. He thus describes the state of the farming interest in his days. He says that the smaller farmers live worse than "those in Bridewell:"—

"And for the best of them they live as uncomfortably, moyling and drudging; what they get they spend; plow, sow, and reap, and all to bring the year about; and can they make even at year's end, if servants' wages can be payd, rent discharged, and teems maintained, and family alive, all is well. I dare say fewer estates are raised, tho in itself an honest calling, than by any calling or employment whatsoever; Whistle it in and whistle it out, as the proverb is."

In proposing his remedies, he discourses of leases, of tenant right, of employing more capital, of vermine (game), and of "slavish custome never affecting ingenuity," as glibly as Richard Cobden, and as confidently as John Bright. He also proposes means for silencing the great plea of the labourers—"Will you set us on worke? We will work if you'll provide it." He speaks very disparagingly of all the agricultural writers of his day except "Master Gabriel Plats," but bears the following testimony to the estimation in which Lord Bacon's works were then held:—"But Sir Francis Bacon's Natural Historie let it have high esteeme, 'tis full of rarities and admiration for true philosophie, and shall be acknowledged as a sun in the theore to these poor and low moonelight discoveries." With all this, however, we cannot now occupy ourselves. It is when our author comes to draining and irrigation, on which he is more diffuse than on any other single topic, that he becomes a man after our own heart. Page after page he insists on the absurdity of putting water of irrigation on the top of your land till you have effectually drawn the existing water out of the bottom:—

"And for thy drayning trench it must be made so deepe it go to the bottome of the cold spewing moyst water that feeds the flagg and rush"—"a yard or foure feet deep if ever thou wilt drayne to purpose." And again, "to the bottome, where the spewing spring lyeth, thou must go and one spade's graft beneath, how deep soever it be, if thou wilt drayne thy land to purpose. I am forced to use repetitions of some things, because of the sutablenesse of the things to which they are applyed, as also because of the slownesse of peoples apprehensions of them, as appears by the non-practise of them, the which wherever you see drayning and trenching you shall rarely finde few or none of them wrought to the bottome." "But for these common and many trenches, ofttimes crooked too, that men usually make in their boggy grounds, some one foot, some two, I say away with them as a great piece of folly, lost labor and spoyl, which I desire to preserve the reader from."*

Equally sagacious are the directions about outfalls "to take thy water clearly from thy drayne." On the subject of straightening tortuous and sluggish watercourses, this man of the Commonwealth was in advance not only of his own day but of ours:—

"A strait water-course cut a considerable depth in a thousand parts of this nation would be more advantageous than we are aware of. And though many persons are interested therein, and some will agree, others will oppose; one creek lyeth on one side of the river in one lord's manor, and another lyeth on the other side: why may not one neighbour change with another when both are gainers? I dare say thousands of acres of very rich land may thereby be gained, and possibly as many more much amended that are almost destroyed."

And he proposes a law which shall give facilities for this improvement, and shall protect all interests. Having discoursed to the Lord General on seven prejudices to land, he thus proceeds:—"The eighth prejudice may be the many water-mills which destroy abundance of gallant land; turning it to a bog, or to mire, or else to flagg, rush, or mareblabb; some mills, worth 10*l.* or 12*l.* per annum, destroy land worth 20*l.*, 30*l.*, or 40*l.* per annum. I knowe it of my own knowledge."—Every word of which is as true in the year 1849 as it was in 1652; and the remedies which he proposes are now even more appropriate and efficient, because we are able to substitute steam power for wind and horses, which he contemplated. To prostrate the weirs on all our sluggish streams would be the greatest recovery of "gallant" land which now remains feasible in England. The day of their doom is probably at hand. Most of our water corn-mills are of barbarous structure, inconveniently situated as to roads, and expensive in the maintenance of their weirs, floodgates, banks, and goats. Many on the larger streams lose one-third of their time in winter from excess of water, and those on the smaller the same amount in summer from deficiency. We remember an instance in which all the mills on the river Soar, in Leicestershire, stood still for six weeks continuously on account of flood. Through all the north and centre of England, as well as through considerable portions of the west, good engine-coal is delivered at all railway stations at from 4*s.* to 7*s.* per ton, and 3*s.* 6*d.* per ton is not an uncommon price at the pits. These prices will be more effective enemies to the beggarly water-mills, and more powerful friends to the gallant lands, than Walter Blith's denunciations. In a report made by Mr. Josiah Parkes to the President of the Board of Health, we find the following remarks, to which we give our hearty assent:—

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* In the materials for forming the conduit in a covered drain, no advance seems to have been made from the time of Cato to that of Walter Blith. Cato says, "Sulcos lapide consternito. Si lapis non erit, perticis saligneis viridibus quoquoversus collatis consternito. Si pertica non erit, sarmentis colligatis." Blith's directions are: "Thou must take good green faggots, willow, alder, elme, or thorne, and lay it in the bottome of thy works; or rather take great pibblestones or flintstones."

"The sluggish rivers of the midland and southern counties of England oppose great impediments to land-drainage, being usually full to the banks, or nearly so, and converted into a series of ponds by milldams erected at a few miles' distance below each other; so that frequently no effectual drainage of the richest alluvial soil, composing the meadows, can be made without forming embankments, or by pumping, or by resort to other expensive means. The greater number of corn and other water-mills throughout England ought to be demolished for the advantage of agriculture, and steam-power should be provided for the millers. I believe that such an arrangement would in most cases prove to be economical for both parties.

"A striking example of the economical and beneficial result arising from the destruction of milldams, and the substitution of steam for water power, has recently been exhibited under the operation of 'The Rye and Derwent Drainage Act,' resulting from the wise and friendly co-operation of the Earls of Carlisle and Fitzwilliam (the chief proprietors), with other landowners, to knock down three milldams and give the millers steam, thereby restoring the river to its natural bed and proper function as the great artery of drainage, and enabling thousands of acres of land to be drained and reclaimed, or brought into more profitable cultivation at a very moderate cost. This excellent work has its termination at New Malton, in Yorkshire.

"If all the rivers of England were surveyed, from the sea to their source, the mills upon them valued, the extent of land injured or benefitted by such milldams ascertained, and the whole question of advantage over injury done to the landowners appreciated and appraised, I have little doubt but that the injury done would be found so greatly to exceed the rental of these mills, deduction being made for the cost of maintaining them, that it would be a measure of national economy to buy up all the mills and give the millers steam power."

We wish our limits would permit us to follow the Captain through the dissertation on over-ploughing, thick and thin sowing, and various sorts of manures, and to extract a very acute passage on the application of chemistry to agriculture. We strongly recommend the third edition of "The English Improver" to such of our readers as are not scared by a discursive style and great neglect of arrangement, and are willing to winnow a great deal of corn out of a very confused heap of chaff. The work is embellished by a frontispiece, at the top of which the royal and parliamentary forces encounter each other in hostile array. In the centre they are beating their swords into ploughshares and their spears into pruninghooks; and at the bottom they are ploughing with two horses abreast, and performing other agricultural operations. Various plates give drawings of a wind-mill fitted with a scoop or lading-wheel for draining fens, and a great number of agricultural tools and implements; among others, "The Harfordshire wheeled plough," condemned by Blith for its clumsiness, but still retaining its place in parts of that county; and "The double Plough, ploughing two furrows at one time," which still lingers in the midland counties. Nor must we forget a picture of the gallant Captain, given in connection with a water-level devised by himself, and which seems to be identical with one lately re-introduced into this country from Italy, and patronized by Prince Albert and other eminent agriculturists. The Captain's figure is very imposing, but in most unagricultural garb—a wig as fine as the Speaker's, ruffles, trunk-hose, and spurs. He holds in his hand the levelling-staff, which is fitted with a sliding bull's-eye after the modern fashion. We part from this sagacious veteran with much affection. A fine patriotic spirit pervades all his reflections, as well as a strict morality, tinged perhaps with a little puritanism.*

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* Since we penned the above, we have observed that Mr. Parkes introduced Captain Blith to his hearers in a lecture delivered at Newcastle before the Royal Agricultural Society, and published in vol. vii. of their Journal. Mr. Parkes has selected for quotation from Blith several of the same passages as ourselves, and he mentions one remark-

In England the two cases of injury from water which has passed through the earth, and water which has not, are very frequently complicated, and run into one another by an almost insensible gradation. Except in very barbarous and some sub-alpine districts, the era of draining for *mere springs* has passed by, and the work has on the whole been well executed. We possess better materials for forming a conduit, and some better tools, but probably no other advantage over old Elkington.* We know very little beyond what he taught us, and perhaps do not require to know more. Joseph Elkington was a man of considerable genius, but he had the misfortune to be illiterate, and to find a very inefficient exponent of his opinions, and of the principles on which he conducted his works, in John Johnstone. Every one who reads the work, which is popularly called Elkington on Draining, should be aware, that it is not Joseph who thinks and speaks therein, but John, who tells his readers what, according to his ideas, Joseph would have thought and spoken. In one portion of the book, entitled "On Hollow and Surface Draining in general," which is discussed in nineteen sections, Johnstone teaches avowedly in his own person, his first sentence being, "This is a part of the draining system not coming within the limits of Mr. Elkington's practice." It is enough to say that these nineteen sections do not contain a single suggestion of any value to a modern drainer. A reader who has some previous acquaintance with the subject will get a general idea of Elkington's discovery and method from the earlier portion of the *book*, though, unless he has seen some of Elkington's *work*, he will not therefrom form an adequate opinion of his sagacity. Johnstone measured by general capacity, is a very shallow drainer. He

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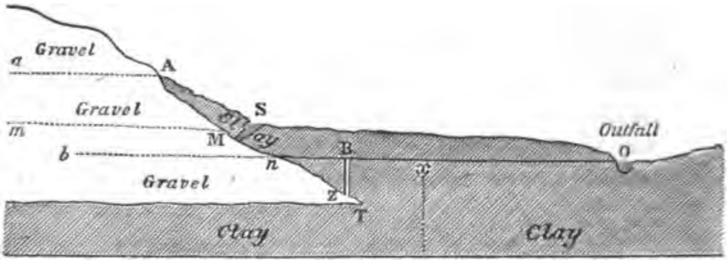
able point which had escaped us, that this old drainer, "prescribes, in all cases, excepting for water-meadows, the driving the drains right up and down the fall of the land."

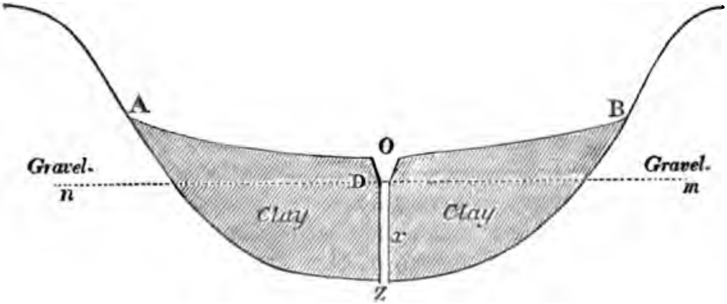
* "An Account of the most approved Mode of Draining Land, according to the System practised by Mr. Joseph Elkington." By John Johnstone, Land Surveyor. Edinburgh, 1797.

delights in exceptional cases, of which he may have met with some, but of which we suspect the great majority to be the products of his own ingenuity, and to be put forward with a view to display the ability with which he could encounter them. We shall pass by such cases altogether. No doubt they are numerous in the aggregate; but they form a very small percentage of the work of draining which has to be done or *re*done in Great Britain. They are moreover for the most part too complicated to be quite understood without actual inspection, too varied for useful classification, and must be left to the skill and sagacity of the operator. A slight modification of Johnstone's best and simplest plan, with a few sentences of explanation, will sufficiently elucidate Elkington's mystery, and will comprehend the case of all simple superficial springs. Perhaps in Agricultural Britain no formation is more common than moderate elevations of pervious material, such as chalk, gravel, and imperfect stone or rock of various kinds, resting upon more horizontal beds of clay or other material less pervious than themselves, and at their inferior edge overlapped by it. For this overlap geological reasons are given, into which we cannot now enter. In order to make our explanation simple, we use the words gravel and clay as generic for pervious and impervious material. Our drawing is an attempt to combine plan and section, which will probably be sufficiently illustrative. From A to T is the overlap,



which is in fact a dam holding up the water in the gravel. In this dam there is a weak place at S, through which water issues permanently (a superficial spring), and runs over the surface from S to O. This issue has a tendency to lower the water in the gravel to the line M *m*. But when continued rains overpower this issue, the water in the gravel rises to the line A *a*, and meeting with no impediment at the point A, it flows over the surface between A and S. In addition to these more decided outlets, the water is probably constantly squeezing in a slow way through the whole dam. Elkington undertakes to drain the surface from A to O. He cuts a drain from O to B, and then he puts down a borehole, an Artesian well, from B to Z. His hole enters the tail of the gravel; the water contained therein rises up it; and the tendency of this new outlet is to lower the water to the line B *b*. If so lowered, it is manifest that it can no longer overflow at A or at S, and the surface from A to O is drained so far as the springs are concerned. Though our section can only represent one spring and one summit overflow, it is manifest that however long the horizontal line of junction between the gravel and clay may be, however numerous the weak places (springs) in the overlap or dam, and the summit overflows, they will all be stopped, provided they lie at a higher level than the line B *b*. If Elkington had driven his drain forward from B to *n*, he would at least equally have attained his object; but the borehole was less expensive. He escapes the deepest and most costly portion of his drain. At *x* he might have bored to the centre of the earth without ever realising the water in this gravel. His whole success, therefore, depended on his sagacity in hitting the point Z.—Another simple and very common case, first successfully treated by Elkington, is illustrated by our second drawing. Between gravel hills lies a dish-shaped bed of clay, the gravel being continuous under the dish. Springs overflow at A and B, and wet the surface from A to O and from B to O. O D is a drain 4 or 5 feet deep, and having an adequate outlet.

D Z a borehole. The water in the gravel rises from Z to D, and is lowered to the level D *m* and D *n*. Of course it ceases to flow over at A and B. If Elkington's heart had failed him when he reached *x*, he would have done no good. All his success depends on his reaching Z, however deep it may lie. Elkington was a discoverer. We do not at all believe that his discoveries hinged on the accident that the shepherd walked across the field with a crow-bar in his hand. When he forced down that crow-bar, he had more in his head than was ever dreamed of in Johnstone's philosophy. Such accidents do not happen to ordinary men. Elkington's subsequent use of his discovery, in which no one has yet excelled him, warrants our supposition that the discovery was not accidental. He was not one of those prophets who are without honour in their own country; he created an immense sensation, and received a parliamentary grant of one thousand pounds. One writer compares his augur to Moses's rod, and Arthur Young speculates, whether, though worthy to be rewarded by millers on one side of the hill for increasing their stream, he was not liable to an action by those on the other for diminishing theirs. He appears to have generally used stones as a conduit, but occasionally a sort of drain-brick, the pattern of which came from France. The duty was not then taken off such materials, and formed a sore impediment to their use and improvement.



After Elkington, we find no notability in draining till we come to Smith of Deanston, and his name at once introduces us to modern practice and modern controversy. We have now to deal with the case of lands which get rid of the rain which falls upon them so slowly, that it becomes either an hindrance to fertility, or an inconvenience to agriculture, or both. This evil is often, perhaps oftener than not, complicated with an almost imperceptible oozing of bottom-water squeezed through the earth by the pressure of superincumbent subterranean reservoirs, existing in higher grounds, situated sometimes at a considerable distance. But the surface-water is the main point, and the bottom-water, if we may so call it, is amenable to the same treatment, and, except in one occasional case*, will be removed by the same means. But we can get on no farther without definitions; and here we are in a difficulty. The nomenclature of draining is indefinite, because the ideas of those who have practised the art have been confused. Probably no other art ever had so long an infancy. In the word soil, we include, for our present purpose, the whole depth to which land is treated in our operations. All our readers will have heard of soils open and stiff—pervious or permeable, and impervious—porous and retentive. We mean to select for use the last pair of these epithets. By porous soils, we mean those which, in their natural state, are capable of filtering through themselves all or the greater part of the rain which falls upon them.

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* When we said that no one had yet excelled Elkington, we were speaking of the treatment of mere springs. In the complicated case to which our text refers, Mr. Parkes has often and most skilfully combined his own more peculiar practice with Elkington's discovery; removing the water from above by parallel thorough-drains, and giving to that which is squeezed up from below an easy access to the same drains by boreholes. This combination would however be useless in the hands of a man who did not inherit somewhat of the old prophet's sagacity. He appears to have dropped his mantle on a man of his own county. Mr. Parkes has introduced a great improvement by securely piping down his boreholes, and by connecting those perpendicular pipes with the pipes in his drain.

By retentive soils, we mean those which, in their natural state, retain the whole or the greater part of the rain which falls upon them, until it has run off by superficial discharge, or has been exhausted by evaporation. Of the terms cut, trench, and drain, we shall use exclusively the latter; and as the word sough or surf has been popularly extended beyond its original meaning, which was simply the artificial aperture left in the re-filled drain for the passage of the water, we shall drop that word altogether, and substitute the word conduit. Our predecessors have used almost indifferently the phrases surface-draining, hollow-draining, the frequent drain system, furrow-draining, and thorough-draining. Of these we shall select the last, as best descriptive of our object. We call that thorough-draining which assimilates retentive soils to porous to this extent, that it enables them to filter through themselves to the depth of the drains all the rain which falls upon their surface; or if that object cannot be entirely attained, the thoroughness of the draining varies inversely as the quantity of water got rid of by other means. By water of drainage, we mean all water existing among the particles of soil beyond that which they are able to retain by attraction. The water of drainage in any soil will stand at a level like any other dammed-up water. In order to avoid circumlocution, we shall ask leave to call this level the water-table. In using the word attraction, we shall drop capillary, which is a favourite with writers on draining. We drop it because it conveys no definite idea to our mind as connected with particles of soil; because attraction is perfectly intelligible; and because every one may, by the simplest experiments, and the use of his own eyes, convince himself that particles of soil have an attraction for water so strong as to overcome to a certain extent the force of gravity.

Imperfect attempts at thorough-draining were probably first made in the southern counties of England. The conduit was usually formed of thorns or other twigs, the cuttings of the hedges, covered with straw. In Leicestershire nearly a century ago, and perhaps earlier, a conduit was formed in clay at the bottom of the drain by a superimposed turf (locally called clod-soughing); and the practice is not quite exploded in that and other counties, which are backward in their agriculture. Attempts, moreover, were made in various parts of England to form a conduit by means of a mole-plough. This instrument had a great but very transient reputation. Smith of Deanston was therefore by no means the author of thorough-draining, but he saw much more clearly than any of his predecessors the benefits to be derived from it, and he has the high merit of having brought them prominently before the public. No doubt whatever can exist that Mr. Smith gave the first effectual impulse to the practice, and to that extent his name is justly associated with thorough-draining. One sentence in an article which he furnished to "The Third Report of Drummond's Agricultural Museum," makes a considerable approach to a right conception of the advantages of thorough-draining, as they are now revealed to us.

"When soil is immediately incumbent on open rock, especially on whin or green-stone, which is very open from its many fissures, the land is always uniformly fertile. If, therefore, we observe carefully the operations of nature, we shall never be at a loss for principles to guide us in the cultivation of the soil. In the last stated example, the open rock under the soil affords frequent and pretty uniform channels of escape for the water; hence the obvious suggestion of the *frequent drain system*."

So utterly innocent was poor Johnstone of any such ideas, that in a chapter on "Hollow-draining in General," he publishes such stuff as follows:—

"In soils that are so tenacious as to retain water on the surface till evaporation carries it off, such as are found in Sussex, Surrey, and in many other counties, this method of draining has been tried, and found entirely to fail."

. . . . "Open trenches, with the ridges and water-furrows properly formed and directed, is the only method whereby its drainage can be effectually accomplished. It is necessary to lay it up in ridges properly placed, and to cut *small open drains* across the ridges where requisite, communicating with each other, and with the furrows; and thus all the water-furrows operate as drains"—a singular conception, certainly, of an art on which he published a book in quarto. Smith's execution was inferior both to his conception and to his zeal. The depth of his frequent drains was not sufficient to attain even the benefits which he foresaw; the materials for his conduit were cumbrous. The quantity of surplus left after refilling, when 15 in. of stone are put into a drain several inches wide at bottom, is very objectionable; and his prices for the execution of the work, when transferred to England, are fabulous. He has the merit of having first stated boldly that all drained lands should be worked flat without ridge or furrow, and he prescribes the line of steepest descent for the general direction of drains, and gives correctly some of the reasons for that practice. If his powers of reasoning had been equal to his zeal, or even to his perception, he would not have allowed himself to be outstripped, as he has been, by others in an art which he had in some degree made his own.

Josiah Parkes, C.E., in a work entitled "Essays on the Philosophy and Art of Land-drainage," published last year,* has very materially extended the objects and benefits of thorough-draining, and for every extension has given authentic instances and philosophical reasons. Mr. Parkes's style is clear and unaffected, and we think that very few holes can be picked in his reasoning. His first Essay is entitled, "On the Influence of Water on the Temperature of Soils;" also, "On the Quantity of Rain-water and its Discharge by Drains." It is the first attempt which we have seen to reduce draining to a science; and, where want of data forbids that object to be obtained, Mr. Parkes indicates very clearly the avenues to future success. The treatise is somewhat too scientific for general agricultural readers, and on that account not fitted to be transferred in the form of a connected abstract into our pages; but it contains several interesting tables, and is pregnant with important facts and accurate deductions, of which we shall avail ourselves, without further acknowledgment, in the remarks on thorough-draining which we propose to offer to our readers. Mr. Parkes's second Essay, the Newcastle Lecture, to which we have already referred, is more popular in its nature, and very practical. Every farmer may read it with advantage. Mr. Mechi has given us "Experience in Drainage." He is an experimentalist in agriculture, and we should think a very sanguine one. With respect to many of his speculative conclusions, we should be sorry to give a directly adverse opinion; but we fear that, in order to escape doing so, we must take refuge in the modified Scotch verdict—not proven. We could not speak harshly of a gentleman whose assistance we crave at our toilet every morning, who imparts so freely to the public his failures as well as his successes, and who appears to bear so good-humouredly the banterings of the London Farmers' Club and the "Mark Lane Express." Moreover, Mr. Mechi asks very acute questions, and makes shrewd remarks, some of which we may not improbably call to our aid.

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* The former of these Essays had appeared in the Journal of the Agricultural Society in 1844, and the latter in 1846.

Here we take our leave of draining literature, and descend to practice. We will assume, without proving, that water of drainage, stagnating in the soil, is prejudicial to esculent vegetation. If this be not so, all that we and our predecessors have learnt and written, has been learnt and written in vain. We will assume, also, that to raise the temperature of what are familiarly and justly called our cold soils, will be beneficial to vegetation. Having made these assumptions, we will prove — 1st, that the main cause of the coldness of these soils is the removal of the water of drainage by evaporation; 2ndly, that their temperature is very much raised during the vegetative season of the year by the removal of this water by efficient drainage; 3rdly, we will state the reasons for our conviction that, in all soils, the existence of the water-table within less than 4 feet of the surface of the land is prejudicial to vegetation; 4thly, we will show that the water of drainage will be best removed at a reasonable expense, and the level of the water-table will be best reduced by frequent parallel drains of a depth never less than 4 feet; 5thly, that the direction of these drains should, as a general rule, be in the line of steepest descent; 6thly, that pipes and collars form a better and cheaper conduit than any other which has been hitherto adopted; and, 7thly, we will give our opinion on the disputed point whether, in the most retentive soils, drains of 4 feet will effectually remove the water of drainage.

1st. The main cause of the coldness of retentive soils is the removal of water of drainage by evaporation.

The evaporation of water produces cold: it cools wine; in hot climates it produces ice. These facts are known to every one. To determine the actual degree of cold produced by the evaporation of one pound of water from soil is rather a complicated, and not a very certain, operation; but scientific reasons are given for an approximation to this result—that the evaporation of one pound of water lowers the temperature of 100 lbs. of soil 10°. That is to say, that if to 100 lbs. of soil holding all the water which it can by attraction, but containing no water of drainage, is added one pound of water which it has no means of discharging except by evaporation, it will, by the time that it has so discharged it, be 10° colder than it would have been if it had the power of discharging this 1 lb. by filtration; or, more practically, that if rain, entering in the proportion of 1 lb. to 100 lbs. into a retentive soil which is saturated with water of attraction, is discharged by evaporation, it lowers the temperature of that soil 10°. If the soil has the means of discharging that 1 lb. of water by filtration, no effect is produced beyond what is due to the relative temperatures of the rain and of the soil. Mr. Dickenson, the eminent paper-maker, who has several mills and a considerable landed estate in Hertfordshire, has deduced from a series of observations, which are, we believe, entitled to great confidence, that of an annual fall of 26 inches of rain, about 11 are filtered through a porous soil. The whole of this 11 inches (and probably more) must be got rid of by a retentive soil, either by evaporation or by superficial discharge. The proportions in which each of these means will operate will vary in every case, but this will be an universal feature, that these 11 inches will maintain in undrained retentive soils, at all except some accidental periods of excessive drought, a permanent supply of water of drainage, which will be in constant course of evaporation, and will constantly produce the cold consequent thereon. Retentive soils never can be so warm as porous, for a simple reason. Every one knows, or may know, that if into two flower-pots, with holes in the bottom, are put respectively equal portions of gravel and clay, equally heated to any point short of torrefaction, and if equal quantities of water are administered to the surface of each, water (water of drainage) will run from the gravel long before it begins to run from the clay. Gravel can hold by attraction much less water than clay can. At the time when each is saturated by water of attraction, and neither holds any water of drainage, evaporation will begin to act upon the water in each, and will act most strongly in the vegetative period of the year. The cold produced will be in proportion to the quantities of water evaporated respectively, and will of course be greatest in the retentive soil. We will reserve a further cause of coolness in retentive soils, which is also connected with evaporation, till we have spoken of the depths of drains.

2nd. The temperature of retentive soils is very much raised during that period of the year in which vegetation is active by the removal of water by drainage.

Many experiments have shown that, in retentive soils, the temperature at 2 or 3 feet below the surface of the water-table is, at no period of the year, higher than from 46° to 48°, *i. e.* in agricultural Britain. This temperature is little affected by summer heats, for the following short reasons. Water, in a quiescent state, is one of the worst conductors of heat with which we are acquainted. Water warmed at the surface transmits little or no heat downwards. The small portion warmed expands, becomes lighter than that below, consequently retains its position on the surface, and carries no heat downwards.* To ascertain the mean heat of the air at the surface of the earth over any extended space, and for a period of eight or nine months, is no simple operation. More elements enter into such a calculation than we have space or ability to enumerate; but we know certainly that, for seven months in the year, air, at the surface of the ground, is seldom lower than 48°, never much lower, and only for short periods: whereas, at 4 feet from the surface, in the shade, from 70° to 80° is not an unusual temperature, and in a southern exposure in hot sunshine double that temperature is not unfrequently obtained on the surface. Now let us consider the effect of drains placed from 2 to 3 feet below the water-table, and acting during the seven months of which we have spoken. They draw out water of the temperature of 48°. Every particle of water which they withdraw at this temperature is replaced by an equal bulk of air at a higher, and frequently at a much higher, temperature. The warmth of the air is carried down into the earth.

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* When water is heated from below, the portion first subjected to the heat rises to the surface, and every portion is successively subjected to the heat and rises, and each, having lost some of its heat at the surface, is in turn displaced. Constant motion is kept up, and a constant approximation to an equal temperature in the whole body. The application of superficial heat has no tendency to disturb the quiescence of water.

The temperature of the soil, to the depth to which the water is removed, is in a course of constant assimilation to the temperature of the air at the surface. From this it follows necessarily, that during that period of the year when the temperature of air at the surface of the earth is generally below 48°, retentive soils which have been drained are colder than those which have not. Perhaps this is no disadvantage. In still more artificial cultivation than the usual run of agriculture, gardeners are not insensible to the advantage of a total suspension of vegetation for a short period. In Britain we suffer, not from an excess of cold in winter, but from a deficiency of warmth in summer. Grapes and maize, to which our sombre skies deny maturity, come to full perfection in many regions whose winters are longer and more severe than ours. However, we state the facts, without asking to put a large amount therefrom to the credit of our drainage. A friend of ours, who lived on the north side of a hill in a subalpine district, did not see the sun for three months in the year. He maintained that this was an advantage: that during those three months the sun was worth nothing to any one: whereas in summer he enjoyed the early beams of that luminary for some hours before he appeared to his neighbours on the south side of the hill, as well as his declining rays after they had lost him. Perhaps our readers may think that what we and our friend take by our respective notions is much on a par. To a beautiful provision of nature, by which, during seasons of excessive heat, summer rains are made subservient to the double purpose of cooling the arid surface and conveying warmth to the deeper recesses of the soil, we can advert only cursorily on account of insufficient data. We have no satisfactory British experiments with reference to the surface-heat of the earth. Professor Leslie's only commence at 1 foot below the surface. Schubler's experiments, made near Geneva, in the year 1796, are strictly superficial. His thermometers were sunk in the soil only to the depth of $\frac{1}{12}$th of an inch. In that sunny clime he found the *mean* heat of soil, at that depth, to be at noon, for six successive months, 131°. If that were his *mean* heat for six months, we cannot doubt that it is frequently obtained as an extreme heat in the hottest portion of our year in England. Mr. Parkes gives temperatures on a Lancashire flat moss, but they only commence at 7 inches below the surface, and do not extend to midsummer. At that period of the year the temperature at 7 inches never exceeded 66°, and was generally from 10° to 15° below the temperature of air in the shade, at 4 feet above the earth. At the depth of 13 inches the soil was generally from 5° to 8° cooler than at 7 inches. Mr. Parkes's experiments were made simultaneously on a drained and on an undrained portion of the moss; and the result was, that, on a mean of 35 observations, the drained soil at 7 inches in depth was 10° warmer than the undrained at the same depth. The undrained soil never exceeded 47°, whereas after a thunder-storm the drained reached 66° at 7 inches, and 48° at 31 inches. Such were the effects at an early period of the year on a black bog. They suggest some idea of what they are, when in July or August thunder-rain at 60° or 70° falls on a surface heated to 130°, and carries down with it into the greedy fissures of the earth its augmented temperature. These advantages porous soils possess by nature, and retentive soils only acquire them by drainage.*

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* The only temperature of thunder-rain given in Mr. Parkes's Tables is 78. This, we imagine, must be an extreme heat. We have heard, with much satisfaction, that Mr. Parkes is, by means of his numerous staff stationed at the works which he is carrying on in many parts of Great Britain, Ireland, and (we believe) France, conducting a series of experiments on the temperatures of water of drainage, which tend to show an increase in some proportion to the length of time for which the drainage has been executed. We know no experiments connected with agriculture to the result of which we look with more hopeful expectation. Any agriculturist may, by means of a delicate thermometer, conduct and record such observations on his own farm. Probably the water of drainage from firm land may be expected to be higher in temperature than that from the quoted bog in summer, and lower in winter.

3rd. In all soils the existence of the water-table nearer than 4 feet from the surface of the land is prejudicial to vegetation. Here open upon us the yelpings of the whole shallow pack. Four feet! The same depth for all soils! Here's quackery! We think Mr. Parkes must have stood in very unnecessary awe of this pack, when he penned the following half apologetic sentence, which is quite at variance with the wise decision with which, in other passages of his works, he insists on depths of four feet and upwards in all soils:—"In respect of the depth at which drains may, with a certainty of action, be placed in a soil, I pretend to assign no rule; for there cannot, in my opinion, be a more crude or mistaken idea than that one rule of depth is applicable with equal efficiency to soils of all kinds." * Those words—equal efficiency—are a sort of saving clause; for we do not believe that when Mr. Parkes wrote them, he entertained "the crude or mistaken idea" of ever putting in an agricultural drain less than 4 feet deep, if he could help it. We will supply the deficiency in Mr. Parkes's explanation, and will show that the idea of a *minimum* depth of four feet is neither crude nor mistaken. And as to "quackery"—which occurs *passim* in the writings and speeches of the shallow drainers—there is no quackery in assigning a minimum. Every drainer does it, and must do it. The shallowest man must put his drains out of the way of the plough and of the feet of cattle. That is his minimum. The man who means to subsoil must be out of the way of his agricultural implement. These two minima are fixed on mechanical grounds. We will fix a minimum founded on ascertained facts and on the principles of vegetation.

Every gentleman who, at his matutinal or ante-prandial toilet, will take his well-dried sponge, and dip the tip of it into water, will find that the sponge will become wet above the point of contact between the sponge and the water, and this wetness will ascend up the sponge, in a diminishing ratio, to the point where the forces of attraction and of gravity are equal. This illustration is for gentlemen of the Clubs, of London drawing-rooms, of the Inns of Court, and for others of similar habits. For gentlemen who are floriculturists, we have an illustration much more apposite to the point which we are discussing. Take a flower-pot a foot deep, filled with dry soil. Place it in a saucer containing three inches of water. The first effect will be that the water will rise through the hole in the bottom of the pot till the water which fills the interstices between the soil is on a level with the water in the saucer. This effect is by gravity. The upper surface of this water is our water-table. From it water will ascend by attraction through the whole body of soil till moisture is apparent at the surface. Put in your soil at 60°, a reasonable summer heat for nine inches in depth, your water at 47°, the seven inches' temperature of Mr. Parkes's undrained bog; the attracted water will ascend at 47°, and will diligently occupy itself in attempting to reduce the 60° soil to its own temperature. Moreover, no sooner will the soil hold water of attraction, than evaporation will begin to carry it off, and will produce the cold consequent thereon. This evaporated water will be replaced by water of attraction at 47°, and this double cooling process will go on till all the water in the water-table is exhausted. Supply water to the saucer as fast as it disappears, and then the process will be perpetual. The system of saucer-watering is reprobated by every intelligent gardener; it is found by experience to chill vegetation; besides which, scarcely any cultivated plant can dip its roots into stagnant water with impunity. Exactly the process which we have described in the flower-pot is constantly in operation on an undrained retentive soil: the water-table may not be within nine inches of the surface, but in very many instances it is within a foot or eighteen inches, at which level the cold surplus oozes into some ditch or other superficial outlet. At 18 inches attraction will, on the average of soils, act with considerable power. Here, then, you have two obnoxious principles at work, both producing cold, and the one administering to the other. The obvious remedy is to destroy their *united* action; to break through their line of communication. Remove your water of attraction to such a depth that evaporation cannot act upon it, or but feebly. What is that depth? In ascertaining this point we are not altogether without data. No doubt depth diminishes the power of evaporation rapidly. Still, as water taken from a 30 inch drain is almost invariably two or three degrees colder than water taken from 4 feet, and as this latter is generally one or two degrees colder than water from a contiguous well several feet below, we can hardly avoid drawing the conclusion that the cold of evaporation has considerable influence at 30 inches, a much diminished influence at 4 feet, and little or none below that depth. If the water-table is removed to the depth of 4 feet, when we have allowed 18 inches of attraction, we shall still have 30 inches of defence against evaporation; and we are inclined to believe that any prejudicial combined action of attraction and evaporation is thereby well guarded against. The facts stated seem to prove that less will not suffice.

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* Smith of Deanston may perhaps be open to some observation, for we believe that he did unadvisedly recommend, in thorough-draining, an equal depth and equal distance for parallel drains in all soils.

So much on the score of temperature, but this is not all. Do the roots of esculents wish to penetrate into the earth—at least, to the depth of some feet? We believe that they do. We are sure of the brassica tribe, grass, and clover. All our experience and observation deny the doctrine that roots only ramble when they are stinted of food; that six inches well manured is quite enough, better than more. Ask the Jerseyman; he will show you a parsnip as thick as your thigh, and as long as your leg, and will tell you of the advantages of 14 feet of dry soil. You will hear of parsnips whose roots descend to unsearchable depths. We will not appeal to the Kentucky carrot, which was drawn out by its roots at the antipodes; but Mr. Mechi's, if we remember right, was a dozen feet or more. Three years ago, in a midland county, a field of good land in good cultivation, and richly manured, produced a heavy crop of cabbages. In November of that year we saw that field broken into in several places, and at the depth of 4 feet the soil (a tenacious marl, fully stiff enough for brick-earth) was occupied by the roots of cabbage, not sparingly —not mere capillæ—but fibres of the size of small pack-thread. A farmer manures a field of four or five inches of free soil reposing on a retentive clay, and sows it with wheat. It comes up, and between the kernel and the manure it looks well for a time, but anon it sickens. An Irish child looks well for five or six years, but after that time potato-feeding, and filth, and hardship, begin to tell. You ask what is amiss with the wheat, and you are told that when its roots reach the clay they are poisoned. This field is then thorough-drained, deep, at least four feet. It receives again from the cultivator the previous treatment; the wheat comes up well, maintains throughout a healthy aspect, and gives a good return. What has become of the poison? We have been told that the rain-water filtered through the soil has taken it into solution or suspension, and has carried it off through the drains, and men who assume to be of authority put forward this as one of the advantages of draining. If we believed it we could not advocate draining. We really should not have the face to tell our readers that water, passing through soils containing elements prejudicial to vegetation, would carry them off, but would leave those which are beneficial behind.* We cannot make our water so discriminating; the general merit of water of deep drainage is, that it contains very little. Its perfection would be that it should contain nothing. We understand that experiments are in progress which have ascertained that water, charged with matters which are known to stimulate vegetation, when filtered through 4 feet of retentive soil, comes out pure.* But to return to our wheat. In the first case, it shrinks before the cold of evaporation and the cold of water of attraction, and it sickens because its feet are never dry; it suffers the usual maladies of cold and wet. In the second case, the excess of cold by evaporation is withdrawn; the cold water of attraction is removed out of its way; the warm air from the surface, rushing in to supply the place of the water which the drains remove, and the warm summer rains, bearing down with them the temperature which they have acquired from the upper soil, carry a genial heat to its lowest roots. Health, vigorous growth, and early maturity are the natural consequences.

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* We do not deny that some subsoils contain matter prejudicial to vegetation, but generally they are not worse than a *caput mortuum*; seldom quite so bad.

We think we have established that all soils will be benefited by the removal of the water-table to 4 feet, which must suffice under this head: and we think every candid reader will be convinced that, by this single operation of lowering the water-table, many soils, hitherto sterile, and consequently much underrated, may be made into useful agricultural land. We will take together the fourth and fifth heads: they will occupy only a few sentences. They relate to the depth and direction of the drains by which the water-table is to be lowered.

Water can only get into drains by gravity, which only acts by descent—technically, by fall; the fall must be proportioned to the friction which the water encounters on its passage. Suppose drains 4 feet deep to be placed 12 yards apart on level land, it is plain that water at that depth, lying at the intermediate point between the two drains, will not get into either of them. A fall of some inches will be required to enable it to overcome the friction of 6 yards of retentive soil. In order, therefore, to lower the water-table to 4 feet at all points, the drains must be some inches deeper than 4 feet. If the land lies on a slope (say 4 inches to the yard), drains of 4 feet, if driven on the line of steepest descent, will effect the object; because, though water at 4 feet, lying at the intermediate point between two drains, in a line at right angles to them, cannot for want of fall get into either of them by travelling 6 yards, it will find a fall of 4 inches at less than 7, and of 8 inches at less than 8, yards. If we must speak quite correctly, this intermediate water will never get into the drain till there is a fresh supply; it will descend perpendicularly, pushing out that which lies below it, and will be itself displaced by a fresh arrival from the heavens. In order that the whole soil, if homogeneous, or nearly so, may be drained evenly, it is manifest that the drains must be parallel. Extra friction in the soil must be met either by making the drains deeper, or by placing them nearer. On this point, which is one of practice rather than of principle, each case must be left to the sagacity of the operator. We doubt whether in any natural soil the friction is so great as to resist a fall of 1 inch in a yard. If we are right in this point, we should always attain the object of lowering the water-table to 4 feet by 4 feet 6-inch drains, parallel, and 12 yards apart. We have already stated one advantage which results on a slope from driving the parallel drains in the line of steepest descent: to wit, that when they are so driven, all water which lies at the same depth from the surface as the bottoms of the drains, can find a fall into one or the other by travelling a little more than half the distance between them; whereas, if the drains are driven across the slope, half the water so situated as to depth can only find a fall into the lower drain, and in order to reach it must travel distances varying from one-half to the full interval between the two. Smith, of Deanston, stated one reason for the steep course, namely, that on slopes alternate horizontal beds of porous and retentive soil frequently cropped out; that the water issuing from the lower edge of the porous runs over the surface of the retentive; that a drain driven across the slope in the retentive leaves this issue untouched: whereas, a drain driven in the line of the slope cuts every one of these horizontal beds, draws the water to the depth of the drain out of the porous, and stops the overflow. Some one comes forward, and says,—"I have seen a case where the alternate beds are parallel, not overlying, perpendicular, not horizontal, and lie in the line of the slope. There your rule will not apply." Quite true! but Smith's case frequently occurs, and is worthy of a general observation; yours is very rare, and is not. You must deal with it according to your ingenuity. But perhaps the greatest recommendation of the steep drain is, that the water gets so freely out of it: it is no sooner in the drain than you are rid of it: whereas, in the horizontal drain it lingers, lying against the lower side, oozing through the land and inviting attraction. In very steep lands, the general direction of the natural cracks is across the line of slope, for the same reasons of gravity as in landslips, breaks in embankments, and other similar cases. Many valleys seem to have obtained their present form by a succession of little landslips, which are still in progress where a stream is washing away the foot. In such cases the steep drain cuts through all the cracks, and relieves them of their water.

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* Since this Essay was first printed, a portion of these experiments has been communicated to the public by Professor Way.

We now come to the conduit.

If sticks, straw, clods, and the mole-plough have not entirely fled before modern improvements, we should unworthily detain our readers by occupying a single line in giving them a parting kick. Stones must not be dismissed quite so summarily: they form an imperfect conduit, but we cannot say that in no situation is it advisable to use them. Many wet common lands on their enclosure, and many of the slopes of moorland hills when first brought into arable cultivation, are exceedingly encumbered with stones. It is almost as cheap to bury them in 4 or 5-feet drains as to cart them into heaps. We have seen instances where as many stones came out of the drain as would form the conduit. Such soils are generally very firm. A narrow slab or inch board, fitting the bottom of the drain, will be a secure foundation for stone, a foot in depth, laid in the form which its nature may suggest. We will answer for the board. In taking up considerable lengths of drains 5 and 6 feet deep, and so laid more than sixty years ago, we have seen no instance in which either oak, alder, birch, or willow has been materially decayed; twigs and sticks, from similar depths, have been equally sound and tough. In the comparatively rare cases to which we have referred, we permit, without approval, the use of a stone conduit. We know no instance in which it is worth while (as Smith recommends) to quarry and break stones to form a conduit.

We shall shock some and surprise many of our readers when we state confidently that in average soils, and, still more, in those which are inclined to be tender, horseshoe tiles form the weakest and most failing conduit which has ever been used for a deep drain. It is so, however, and a little thought, even if we had no experience, will tell us that it must be so. A doggerel song, quite destitute of humour, informs us that tiles of this sort were used in 1760 at Grandesburg Hall, in Suffolk, by Mr. Charles Lawrence, the owner of the estate. The earliest of which we had experience were of large area and of weak form. Constant failures resulted from their use, and the cause was investigated; many of the tiles were found to be choked up with clay, and many to be broken longitudinally through the crown. For the first evil two remedies were adopted; a sole of slate, of wood, or of its own material, was sometimes placed under the tile, but the more usual practice was to form them with club-feet. To meet the case of longitudinal fracture, the tiles were reduced in size, and very much thickened in proportion to their area. The first of these remedies was founded on an entirely mistaken, and the second on no conception at all of the cause of the evil to which they were respectively applied. The idea was, that this tile, standing on narrow feet, and pressed by the weight of the refilled soil, sank into the floor of the drain; whereas, in fact, the floor of the drain rose into the tile. Any one at all conversant with collieries is aware that when a *strait* work (which is a small subterranean tunnel 6 feet high and 4 feet wide or thereabouts) is driven in coal, the rising of the floor is a more usual and far more inconvenient occurrence than the falling of the roof: the weight of the two sides squeezes up the floor. We have seen it formed into a very decided arch without fracture. Exactly a similar operation takes place in the drain. No one had till recently dreamed of forming a tile drain, the bottom of which a man was not to approach personally within 20 inches or 2 feet. To no one had it then occurred that width at the bottom of the drain was a great evil. For the convenience of the operator the drain was formed with nearly perpendicular sides, of a width in which he could stand and work conveniently, shovel the bottom level with his ordinary spade, and lay the tiles by his hand; the result was a drain with nearly perpendicular sides and a wide bottom. No sort of clay, particularly when softened by water standing on it or running over it, could fail to rise under such circumstances; and the deeper the drain the greater the pressure, and the more certain the rising. A horseshoe tile, which may be a tolerably secure conduit in a drain of 2 feet, in one of 4 feet becomes an almost certain failure. As to the longitudinal fracture—not only is the tile subject to be broken by one of those slips which are so troublesome in deep draining, and to which the lightly-filled material, even when the drain is completed, offers an imperfect resistance, but the constant pressure together of the sides, even when it does not produce a fracture of the soil, catches hold of the feet of the tile, and breaks it through the crown. Consider the case of a drain formed in clay when dry, the conduit a horseshoe tile. When the clay expands with moisture, it necessarily presses on the tile, and breaks it through the crown, its weakest part.* When the Regent's Park was first drained, large conduits were in fashion, and they were made circular by placing one horseshoe tile upon another. It would be difficult to invent a weaker conduit. On re-drainage, innumerable instances were found in which the upper tile was broken through the crown, and had dropped into the lower. Next came the ⌓ form, tile and sole in one, and much reduced in size—a great advance; and when some skilful operator had laid this tile bottom upwards we were evidently on the eve of pipes. For the ⌓ tile a round pipe moulded with a flat-bottomed solid sole $\underline{O}$ is now generally substituted, and is an improvement; but is not equal to pipes and collars, nor generally cheaper than they are.

Almost forty years ago small pipes for land-drainage were used concurrently by the following parties, who still had no knowledge of each other's operations:—Sir T. Wichcote, of Asgarby, Lincolnshire (these we believe were socket-pipes)—Mr. R. Harvey, at Epping—Mr. Boulton, at Great Tew in Oxfordshire (these were porcelain 1-inch pipes made by Wedgwood, at Etruria)—and Mr. John Read, at Horsemonden, in Kent. Most of these pipes were made with eyelet-holes to admit the water. Pipes for thorough-draining were incidentally mentioned in the Journal of the Agricultural Society, for May 1843, but they excited no general attention till they were exhibited by John Read (the inventor of the stomach-pump) at the Agricultural Show at Derby in that year. A medal was awarded to the exhibitor. Mr. Parkes was one of the Judges, and brought the pipes to the special notice of the Council, and was instructed by them to investigate their use and merits. From this moment inventions and improvements huddle in upon us faster than we can describe them. Collars to connect the pipes, a new form of drain, tools of new forms,—particularly one by which the pipe and collar are laid with wonderful rapidity and precision, by an operator who stands on the top of the drain—and pipe-and-collar-making machines (stimulated by repeated prizes offered by the Royal Agricultural Society), which furnish those articles on a scale of unexampled cheapness. For all these inventions and adaptations we are mainly indebted to Mr. Parkes. The economical result is, a drain 4 feet 6 inches deep, excavated and refilled at from 1¼*d.* to 2*d.* per yard—the workmen earning 12*s.* and upwards per week; and 333⅓ yards of collared 1¼-inch pipes for 18*s.*—being 12*s.* per thousand for the pipes, and 6*s.* per thousand for the collars; larger sizes at a proportionate advance. We shall best exemplify the improvements to our readers by describing the drain. It is wrought in the shape of a wedge, brought in the bottom to the narrowest limit which will admit the collar by tools admirably adapted to that purpose. The foot of the operator is never within 20 inches of the floor of the drain; his tools are made of iron plated on steel, and never lose their sharpness, even when worn to the stumps; because, as the softer material, the iron, wears away, the sharp steel edge is always prominent. The sloping sides of the drain are self-sustaining, and the pressure on its floor is reduced to a minimum; the circular form of the pipe and collar enables them to sustain any pressure to which they can be subjected; the adaptation of the bed in which they lie to their size prevents their riggling. They form a continuous conduit, and whose continuity cannot be broken except by great violence. However steep the drain, the water running in the pipe can never wash up its floor. They offer almost insuperable impediments to the entrance of vermin, roots,* or anything except water, and they are more portable both to the field and in the field than any other conduit previously discovered: cheap, light, handy, secure, efficacious.

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* The tile has been said, by great authorities, to be broken by contraction, under some idea that the clay envelopes the tile and presses it when it contracts. That is nonsense. The contraction would liberate the tile. Drive a stake into wet clay; and when the clay is dry, observe whether it clips the stake tighter or has released it, and you will no longer have any doubt whether expansion or contraction breaks the tile. Shrink is a better word than contract.

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* I am afraid that I must materially modify this expression as far as roots are concerned. The words "almost insuperable impediments" are

Perhaps some of our readers will boggle at this word efficacious. Doubts will begin to trouble inexperienced minds;—Will water get freely into these narrow-bottomed drains? Will pipes of this small capacity convey it away? The scepticism is natural; but on each point we are able to offer them abundant consolation and conviction—consolation from experience, conviction on argument. We have seen hundreds of drains wrought in the manner we have described and laid with pipes, and in no instance where the land contained water-of-drainage have they failed to run freely. We never heard any one say they did not. This ought to satisfy every person who is not of his own knowledge aware of an instance to the contrary: "Quod semper,

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not applicable. My own experience as to roots, in connexion with deep pipe draining, is as follows:—I have never known roots to obstruct a pipe through which there was not a perennial stream. The flow of water in summer and early autumn appears to furnish the attraction. I have never discovered that the roots of any esculent vegetable have obstructed a pipe. The trees which, by my own personal observation, I have found to be most dangerous, have been red willow, black Italian poplar, elder, ash, and broad-leaved elm. I have many alders in close contiguity with important drains, and, though I have never convicted one, I cannot doubt that they are dangerous. Oak, and black and white thorns, I have not detected, nor do I suspect them. The guilty trees have in every instance been young and free growing; I have never convicted an adult. These remarks apply solely to my own observation, and may of course be much extended by that of other agriculturists. I know an instance in which a perennial spring of very pure and (I believe) soft water is conveyed in socket pipes to a paper-mill. Every junction of two pipes is carefully fortified with cement. The only object of cover being protection from superficial injury and from frost, the pipes are laid not far below the sod. Year by year these pipes are stopped by roots. Trees are very capricious in this matter. I was told by the late Sir R. Peel that he sacrificed two young elm trees in the park at Drayton Manor to a drain which had been repeatedly stopped by roots. The stoppage was nevertheless repeated, and was then traced to an elm tree far more distant than those which had been sacrificed. Early in the autumn of 1850 I completed the drainage of the upper part of a boggy valley lying, with ramifications, at the foot of marly banks. The main drains converge to a common outlet, to which are quod ubique, quod inter omnes" is, if we remember right, a sufficient ground of faith; but on argument the water must get into the drain, and must get into the pipes. This is a matter on which we have seen even sensible men so muddle-headed that we fear we must be elementary. We will assume the drain to be 4 feet deep, and the water-table to be at 1 foot below the surface of the earth. Every particle of water which lies at 3 feet below the water-table has on it the pressure of a column of water 3 feet high; this pressure will drive the particle in any direction in which it finds no resistance, with a rapidity varying inversely to the friction of the medium through which the column acts. The bottom of our drains will offer no resistance, and into it particles of water will be pushed, in conformity with the rule which we have stated; rapidly, if the medium opposes little friction; slowly, if it opposes much. The water so pushed in runs off by the drain, the column of pressure

brought one 3-inch pipe and three of 4 inches each. They lie side by side, and water flows perennially through each of them. Near to this outlet did grow a red willow. In February 1852, I found the water breaking out to the surface of the ground about 10 yards above the outlet, and was at no loss for the cause, as the roots of the red willow showed themselves at the orifice of the 3-inch and of two of the 4-inch pipes. On examination I found that a root had entered a joint between two 3-inch pipes, and had travelled 5 yards to the mouth of the drain, and 9 yards up the stream, forming a continuous length of 14 yards. The root which first entered had attained about the size of a lady's little finger; and its ramifications consisted of very fine and almost silky fibres, and would have cut up into half a dozen comfortable boas. The drain was completely stopped. The pipes were not in any degree displaced. Roots from the same willow had passed over the 3-inch pipes, and had entered and entirely stopped the first 4-inch drain, and had partially stopped the second. At a distance of about 50 yards a black Italian poplar, which stood on a bank over a 4-inch drain, had completely stopped it with a bunch of roots. The whole of this had been the work of less than 18 months, including the depth of two winters. A 3-inch branch of the same system runs through a little group of black poplars. This drain conveys a full stream in plashes of wet, and some water generally through the winter months, but has not a perennial flow. I have perceived no indication that roots have interfered with this drain. I draw no general conclusions from these few facts, but they may assist those who have more extensive experience in drawing some, which may be of use to drainers.—T. G.

being diminished in proportion to the water which runs off. Into the spot which offers no resistance, be it large or be it small, the water above that level must be pushed till the column is so reduced that its weight will not overcome friction. As friction will be greatest at the intermediate point between two parallel drains, the water will stand a little highest at that point, and will decline in a regular gradation to the level of the bottom of each drain. Take a familiar illustration—for, like Walter Blith, we are obliged to use repetitions, though we will not follow his example in saying why. In a soil which is saturated with water—(and by saturated we mean that, in addition to its water of attraction, it has the interstices between its particles filled with water of drainage)—sink a deep hole, no matter how narrow; it will stand full of water. Draw the water out rapidly—it will fill again from the bottom. Into the space where there is no resistance the water must come. This is a parallel case to the bottom of the drain from which the water runs off—the point of non-resistance remains, and to it all the water in the soil must come up to the limit which we have above assigned. Will the small pipes carry off the water? This is a mere question of capacity, and can be decided by accurate calculation; the calculation is given at length in pp. 43-45 of Mr. Parkes's Essays. We will only state the result. If an acre of land be intersected with parallel drains 12 yards apart, and if on that acre should fall the very unusual quantity of 1 inch of rain in 12 hours, in order that every drop of this rain may be discharged by the drains in forty-eight hours from the commencement of the rain—(and in a less period that quantity neither will, nor is it desirable that it should, filter through an agricultural soil)—the interval between two pipes will be called upon to pass two-thirds of a table-spoonful of water per minute, and no more. Inch pipes, lying at a small inclination, and running only half-full, will discharge more than double this quantity of water in forty-eight hours. The mains or receiving drains are of course laid with larger pipes. Experience has established this average, that a 3-inch pipe will discharge the water of 9 acres, 4 of 16, and so on; the quantity of acres being equal to the product of the diameter of the pipe in inches multiplied into itself.

We were astounded to find at the conclusion of Mr. Parkes's Newcastle Lecture this sentence:—"It may be advisable for me to say, that in clays, and other clean-cutting and firm-bottomed soils, I do not find the collars to be indispensably necessary; although I always prefer their use." This is a barefaced treachery to pipes; an abandonment of the strongest point in their case—the assured continuity of the conduit. Every one may see how very small a disturbance at their point of junction would dissociate two pipes of 1 inch diameter. One finds a soft place in the bottom of the drain, and dips his nose into it 1 inch deep, and cocks up his other end. By this simple operation the continuity of the conduit is twice broken. An inch of lateral motion produces the same effect. Pipes of a larger diameter than 2 inches are generally laid without collars; this is a practice on which we do not look with much complacency; it is the compromise between cost and security, to which the affairs of men are so often compelled. No doubt a conduit from 3 to 6 inches in diameter is much less subject to a breach in its continuity than one which is smaller; but when no collars are used the pipes should be laid with extreme care, and the bed which is prepared for them at the bottom of the drain should be worked to their size and shape with great accuracy.

To one advantage which is derived from the use of collars we have not yet adverted—the increased facility with which free water existing in the soil can find entrance into the conduit. The collar for a 1½-inch pipe has a circumference of 3 inches. The whole space between the collar and the pipe on each side of the collar is open, and affords no resistance to the entrance of water; while at the same time the superincumbent arch of the collar protects the junction of two pipes from the intrusion of particles of soil. We confess to some original misgivings that a pipe resting only on an inch at each end, and lying hollow, might prove weak and liable to fracture by weight pressing on it from above; but the fear was illusory. Small particles of soil trickle down the sidesof every drain, and the first flow of water will deposit them in the vacant space between the two collars. The bottom, if at all soft, will also swell up into any vacancy. Practically, if you re-open a drain well laid with pipes and collars, you will find them reposing in a beautiful nidus, which, when they are carefully removed, looks exactly as if it had been moulded for them.

And now for the controversy between the deep and the shallow.

We shall dismiss with a very few words two classes of writers on the subject of draining—1st. Those who limit the advantages of a drain to the water which is passed into it from its own surface, and who therefore enjoin that it should be filled with porous material, and that it should be shallow. 2nd. Those who will not drain 4 or 5 feet deep because it makes the ground too dry for the roots of plants. This idea must have come from some garret, having been conceived by an ingenious recluse brooding over his ignorance, and reasoning as follows:—What makes vegetation burn up? The absence of water from its roots. What takes away the water? Deep drains. Ergo, deep drains are the cause of burning. We will supply a formula:—Why does vegetation burn? Because its roots are very superficial. Why superficial? Because they won't face the cold of stagnant water. What removes the cold and the water? Deep drains. And the facts exactly coincide with our logic. Deep-drained lands never do burn. Nothing burns sooner than a few inches of soil on a very retentive clay. No land is less subject to burn than the same soil when by 4 or 5 feet draining a range of 3 or 4 feet has been given to the previously superficial roots.

Having dismissed these two small matters, we must treat more respectfully a lingering scepticism as to the efficacy of deep drains in very retentive soils; and instead of wondering at this scepticism, we wonder rather that deep thorough-draining has so rapidly made converts. Representations are made of soils which consist of some inches of a moderately porous material reposing on a subsoil which is said to be impervious; and we are told that it is of no use to make the drain deeper into the impervious matter than will suffice for laying the conduit. If the subsoil is impervious, as glass or even as cast-iron or caoutchouc are impervious, we at once admit the soundness of the argument. We only want to ask one question—Is your subsoil moister after the rains of midwinter than it is after the drought of midsummer? if it is it will drain. Mr. Mechi asks, shrewdly enough, "If your soil is impervious, how did you get it wet?" This imperviousness is always predicated of strong clays—plastic clays they are sometimes called. We really thought that no one was so ignorant as not to be aware that clay lands always shrink and crack with drought, and the stiffer the clay the greater the shrinking, as brickmakers well know. In the great drought 36 years ago, we saw, in a very retentive soil in the Vale of Belvoir, cracks which it was not very pleasant to ride among. This very summer, on land which, with reference to this very subject, the owner stated to be impervious, we put a walking-stick 3 feet into a sun-crack without finding a bottom, and the whole surface was what Mr. Parkes not inappropriately calls a net-work of cracks. When heavy rain comes upon the soil in this state, of course the cracks fill, the clay imbibes the water, expands, and the cracks are abolished. But if there are 4 or 5 feet parallel drains in the land, the water passes at once into them, and is carried off. In fact, when heavy rain falls upon clay lands in this cracked state it passes off too quickly without adequate filtration. Into the fissures of the undrained soil the roots only penetrate to be perished by the cold and wet of the succeeding winter; but in the drained soil the roots follow the threads of vegetable mould which have been washed into the cracks, and get an abiding tenure. Earth-worms follow either the roots or the mould. Permanent schisms are established in the clay, and its whole character is changed. An old farmer in a midland county began with 20-inch drains across the hill, and without ever reading a word, or we believe conversing with any one on the subject, poked his way step by step to 4 or 5 feet drains in the line of steepest descent. Showing us his drains this spring, he said—"They do better year by year; the water gets a habit of coming to them." A very correct statement of the fact, though not a very philosophical explanation. Year by year the average dryness of the soil increases, the cracks are farther extended, and seldomer obliterated. A man may drain retentive soils deep and well, but he will be disappointed if he expects what is unreasonable. No intellegent and honest operator will say more, than that money judiciously expended in draining them will pay good, and generally very good, interest. If you eat off turnips with sheep, if you plough the land, or cart on it, or in any way puddle it when it is wet, of course the water will lie on the surface, and will not go to your drains. A 4-feet drain may go very near a pit or a water-course without attracting water from either, because water-courses almost invariably puddle their beds, and the same effect is produced in pits by the treading of cattle, and even by the motion of the water produced by wind. A very thin film of puddle always wet on one side is impervious because it cannot crack.

No system of draining can relieve soils of water-of-attraction. That can only be exhausted by evaporation. Retentive soils hold it in excess; its reduction by evaporation produces cold; and therefore retentive soils never can be so warm as porous. Expect reasonable things only of your drained retentive soils, and you will not be disappointed. Shallow drainers start with the idea of a drop of water falling on the top of the soil, and working its solitary way through narrow and tortuous passages to a drain; and they say that it would be lost in the labyrinth, which we think very likely. They have no idea that the water operated upon by the drain is that which lies at the level of its own bottom, which runs off, and is replaced by that which was immediately above it. And on account of this operation, which we have before explained, it is necessary in retentive soils, in which friction is greater than in porous, to have the drains deeper, in order to lower the water-table to the same extent. A column of 6 inches may suffice to push water from the intermediate point between two drains in a porous soil, and it may require a 12-inch column in a retentive. In that case the drain in the retentive soil must be 6 inches deeper than in the porous. Ignorance says, Drain shallower because your soil is retentive. Experience and reason say, Drain deeper. We may here notice that in clay lands the portion within 1 or 2 feet of the surface is almost always more retentive than that which lies below; simply, we apprehend, because its particles have been comminuted and packed close by the alternate influences of wet and dry, heat and cold. When dried below by drains, and above by evaporation, it is certain to crack and become permeable; and this operation may, if necessary, be assisted by subsoiling or other artificial means.

The practice of deep thorough-draining is not quite new in England, for, if we remember right, Arthur Young states that the best draining which he saw in his agricultural tour was in Yorkshire, on an estate of Lord Rockingham's, by parallel drains 4 feet deep running in the line of steepest descent. Nothing more was heard of the matter till a few successful cases in Kent and Sussex were offered to the notice of agriculturists. No sooner, however, was the practice advocated strongly by Mr. Parkes and others, than a host of correspondents of various agricultural publications furnished more instances of the abandonment of deep draining on account of failure than, we verily believe, they could have authenticated cases of practice. Probably it is not now necessary to advert further to such statements. We believe that they have subsided into quiet oblivion. The practice so derided and maligned has advanced with wonderful strides. We remember the days of 15 inches; then a step to 20; a stride to 30; and the last (and probably final) jump to 50, a few inches under or over. We have dabbled in them all, generally belonging to the deep section of the day. We have used the words "probably final" because the first advances were experimental, and though they were justified by the results obtained, no one attempted to explain the principle on which benefit was derived from them. The principles on which the now prevailing depth is founded, and which we believe to be true, go far to show that we have attained all the advantages which can be derived from the removal of water in ordinary agriculture. We do not mean that, even in the most retentive soil, water would not get into drains which were laid somewhat deeper; but to this there must be a not very distant limit, because pure clay, lying below the depth at which wet and drought applied at the surface would expand and contract it, would certainly part with its water very slowly. We find that in coal mines and in deep quarries a stratum of clay of only a few inches thick interposed between two strata of pervious stone will form an effectual bar to the passage of water; whereas, if it lay within a few feet of the surface, it would in a season of heat and drought become as pervious as a cullender. But when we have got rid of the cold arising from the evaporation of free water, have given a range of several feet to the roots of grass and cereals, and have enabled retentive land to filter through itself all the rain which falls upon its surface, we are not, in our present state of knowledge, aware of any advantage which would arise from further lowering the surface of water in agricultural land. Smith, of Deanston, first called prominent attention to the fertilizing effects of rain filtered through land, and to evils produced by allowing it to flow off the surface. Any one will see how much more effectually this benefit will be attained, and this evil avoided, by a 4 feet than by a 2 feet drainage. The latter can only prepare 2 feet of soil for the reception and retention of rain, which 2 feet being saturated will reject more, and the surplus must run off the surface, carrying whatever it can find with it. A 4 feet drainage will be constantly tending to have 4 feet of soil ready for the reception of rain, and it will take much more rain to saturate 4 feet that 2. Moreover, as a gimlet-hole bored 4 feet from the surface of a barrel filled with water will discharge much more in a given time than a similar hole bored at the depth of 2 feet, so will a 4 feet drain discharge in a given time much more water than a drain of 2 feet. One is acted on by a 4-feet, and the other by a 2-feet, pressure.

We have something to say on the score of authority. The late Sir Robert Peel was a great drainer. He began shallow, was disappointed at the results, and adopted deep draining. He began with miscellaneous conduits—but settled into pipes and collars. Within the last six or seven years of his life, Sir R. Peel drained 2000 acres in the counties of Warwick, Stafford, and Lancaster—a portion (perhaps considerable) on the requisition of tenants. Reports were industriously circulated by speech and writing, that Sir Robert was dissatisfied with the results of his deep draining, in consequence of which a letter was addressed to him, to which he gave a prompt reply. He laid his correspondent under no restrictions as to the use of that reply, and it has been kindly communicated to us. We extract the following sentences:—

"It is utterly untrue that I am dissatisfied with the experiment of deep draining. I have had many prejudices to contend against; the purely stupid ones against any novelty—any innovation on the old system of agriculture; those too prompted by self-interested jealousy of the new machinery which innovation renders necessary. . . . . I have permitted some drains to be laid at less than 4 feet, partly to humour tenants on strong clays, who wished to avoid the expense of very close draining at the additional depth. . . . If I had a field in my own occupation of stiff clay, I should place close drains 21 or perhaps 18 feet apart; but I should prefer 4 feet, notwithstanding the additional expense, to 3."

After a caution against dogmatizing and presuming "that a rule good in their own case must necessarily be good in every other," he thus proceeds:—

"I can conceive a case in which, if you had a limited sum to expend—say 4*l.* an acre—the nature of the ground might be such that the increased closeness might compensate for diminished depth—I mean, for instance, that drains 18 feet apart and 3 feet deep might be more effectual than drains 25 feet apart and 4 feet deep."

Sir Robert then touches on the importance of "breaking up that indurated mass which the trampling of many successive years has formed," to which, as he says, sufficient attention is seldom paid. Probably the words "in my own occupation," quoted above, have reference to the consciousness of the writer that stiff clays are frequently so occupied after drainage as to render the operation of little or no value. The whole letter shows a complete acquaintance with the subject of thorough-draining.

Perhaps the Earl of Lonsdale was the first large landowner who *by personal observation* became convinced of the agricultural advantages of deep draining. He picked up this knowledge during his able superintendence of the metropolitan roads, and has applied it very diligently on his extensive estates, and is we believe applying it still. But he must speak for himself. On the 22nd Sept. 1849, at an agricultural gathering in Carlisle, he made the following very decisive observations:—

"My noble friend has alluded to my draining. I will tell you frankly where I learnt the art. My noble friend has spoken of my management of the metropolitan roads. That was a little plaything compared to what I have since experienced. It is a fact, however, that I learned draining not in the country, but in the town, even in the great town of London, and then forgot it until I came in possession of my property in Westmoreland and Cumberland. Many of you, I dare say, know that some portion of the county of Middlesex is low and flat, with a strong clay. We found that what we called shallow draining took a little water off the surface of the roads, but did not strengthen or harden the foundations; the roads were soon in as bad a state as ever. After various consultations upon the subject with a friend of mine, we determined to drain 5 or 6 feet deep. From that moment their maintenance did not involve half the previous expense. We had extensive powers in that Act, and I remember on one occasion we were driving a drain through a gentleman's garden, which it was necessary to do on that particular spot. The owner, of course, was offended, and cried out: he lustily protested against our interference, appealed to the Legislature, and in every way opposed our measures. We, however, persevered in our drainage; and two years afterwards the same gentleman came to us and said, 'I can't think what has happened to my garden, for the vegetables come a month earlier than they used to do, and remain good on the ground a month later.' Originally, I admit, then, I learned draining in the metropolitan roads; and all my other experience in later years leads me to think, notwithstanding what has been said in its favour, that shallow draining of 2 feet, or 2½ feet deep, is three-fourths of your money thrown away. I know gentlemen at public meetings are apt to make concessions about draining, but upon that point I am very firm, because I believe, nay, I know, I am sure, that deep draining is decidedly the best; and I never yet in all my experience—and I have gone over as much land as any one in the kingdom, for though late in life I have again taken to the chase, and keep a pack of hounds at Tring; and with reference to Hertfordshire, Buckinghamshire, Oxfordshire, and Bedfordshire, I can say that I am perpetually riding over farmers' lands in those counties, and I know, I say, as well to what depth that land is drained as if I had seen or done it myself. I look upon it, and I wish you to view it in the same light, that when you are putting in shallow drains you are incurring a dead loss; and I would urge you to examine the difference between the effect of the two systems, for nothing can be more striking than the contrast presented by land under deep and shallow draining. I have seen this exemplified on the estates of two friends of mine, the Duke of Northumberland and the Duke of Bedford, two noblemen of very opposite opinions, and each residing in different parts of the country, but both most energetic in endeavouring to improve their lands. The Duke of Bedford, although his predecessor laid out large sums of money in shallow draining, has now entirely discarded the system. In fact, deep draining is the only system that can with a certainty of success be adopted; and I would advise you, gentlemen, before you lay out money upon what is called shallow draining—especially as capital is not yet cheap, and you would still have to pay more than 3½ per cent. for it—to consult and examine those lands that have been subjected to the other system. In particular soils, no doubt, you may drain a little too wide, and you will have to rectify the evil, as it is called, afterwards; but as to the depth of the drain, there can be no dispute. It was only the other day I received a report from a tenant on a farm of my own near Whitehaven, which was as wet a place as could be conceived, and I believe the land was rather looked upon with dismay by the farmer when he saw it cut and hacked about in that fashion; but this year he has reaped the benefits of deep draining, and he reports to me that while the occupiers of the adjoining farms formerly always secured their crops before him, he now gets his in before any of them, and his harvest this year has come three weeks earlier than usual. Such has been my experience on this important subject."

Space forbids our taking more than a passing notice of the Acts of Parliament which have been recently passed for advancing public, and facilitating the advance of private, money on the security of lands to be improved by draining. They mark the strong hold which the subject has on the minds of agriculturists. Both the Acts and the evidence on which they are founded will be interesting to those landowners who require *æs alienum* to assist in carrying out their improvements.

One word with our readers before we part. They may dislike the terms to the use of which we have been driven, and we are by no means unconscious of their imperfections; but we hope that we have so limited them by definition as to remove much of their ambiguity. Our purpose has been to bring, in a connected view, before them the objects and the advantages of thorough-draining, and to explain in a popular way the principles on which those objects are carried out and those advantages are attained. That to remove water, which is either injurious to vegetation or obstructive to agricultural operations, is one object of draining, is patent to every one. That if it be removed by superficial discharge it will carry off with it elements beneficial to vegetation, because they form the most soluble part of soils, no one will doubt, though he may not have fully realized to himself what very hateful things furrows, and ditches, and water-grips, and other artificial aids to this superficial discharge really are. It requires but little observation to discover that, with few exceptions, porous soils are fertile, and with equally few very retentive soils are sterile. But the persons are less numerous who are aware that the greatest object and the most important advantage of thorough-draining is, that it warms and ventilates retentive soils. Of warmth we have spoken largely. Ventilation is more obscure. But close observation of agriculture and of horticulture will not allow us to doubt that alternation of fresh air and of fresh water are conducive to fertility. It is not unreasonable to suppose that as stagnant air ceases to sustain the lives of men and animals, and stagnant water the lives of fishes, so stagnant air and water may cease to administer to the purposes of vegetation. In cultivable land in our climate, porousness, either natural or artificial, is the only known avenue to warmth and ventilation.

Some points of practice have found their way into our dissertation, but we have not sought to give a manual—indeed, we have studiously endeavoured to avoid it. If we should give a stimulus to amateur draining we shall do a great deal of harm. We wish we could publish a list of the moneys which have been squandered in the last forty years in amateur draining, either ineffectually or with very imperfect efficiency. Our own name would be inscribed in the list for a very respectable sum. Every thoughtless squire supposes that by the aid of his ignorant bailiff he can effect a perfect drainage of his estate; but there is a worse man behind the squire and the bailiff—the draining conjuror. We knew a jockey at Newmarket, a solemn and mysterious man. His first master told us that he was an idiot—that he could never in his life get a reason from him. "But," said he, "he is an inspired idiot on horseback." So the village conjuror, by dint of mystery and one lucky hit among a score of failures, is supposed to receive inspiration as soon as he takes the draining spade in his hand. These fellows never go direct about their work. If they attack a spring, they try to circumvent it by some circuitous route. They never can learn that Nature shows you the weakest point, and that you should assist her—that *Hit him straight in the eye* is as good a maxim in draining as in pugilism. An evangelical clergyman complained to the Rev. Charles Simeon that when he wished to preach extempore, utterance was denied to him; he supposed because he lacked faith. "*Olli subridens*," the venerable man replied; "No, my dear brother, justification is by faith, but extempore preaching is by works." Neither the squire nor the bailiff nor the conjuror lacks faith, but they are sadly deficient in good works—in education, in knowledge, in science, in accurate thought, in experience—in short, in everything which in complicated operations conduces to success. If you wish to drain, we recommend you to take advice. We have disposed of the quack, but there is a faculty, not numerous but extending, and whose extension appears to us to be indispensable to the satisfactory progress of improvements by draining—a faculty of draining engineers. If we wanted a profession for a lad who showed any congenial talent, we would bring him up to be a draining engineer.

What we preach we practise. After thirty-six years of experience, we became tired of struggling with unskilful workmen, bad tools, and worse supervision. A perusal of one of Mr. Parkes's essays induced us to look carefully into his works, and we then asked his assistance. Of course we do not mention Mr. Parkes's name to the exclusion of, or even in preference to, that of any other engineer who may have equal abilities and attainments; and if we did, we should only lead the great majority of those who wish to drain into error, for we believe that, except in cases of considerable extent, it is hardly possible to secure his services. We cannot disparage our own skill, and in truth we called in Mr. Parkes as a measure of economy. A short detail of our proceedings (similar, no doubt, to those of other land-owners with other engineers) will best explain how we have secured that advantage. We proceeded together to the ground, where we made trial-holes, and concerted outfalls, and directions, and depths, and frequency. We have no doubt that Mr. Parkes would have been quite as well satisfied to settle all these points without any concert on our part. Then we began to differ. We were impatient, and wanted to begin, but Mr. Parkes would not turn a sod till he saw pipes and tools and fifteen tolerable spademen, with their ordinary spades and picks, on the ground. He furnished us with a list of tools, which we procured from Mr. A. Lyndon of Birmingham. They appear to be of a very enduring sort, and are extremely liked by the workmen: a set for from fifteen to twenty men costs five guineas. Mr. Parkes calculated the number and sizes of the pipes which would be required, and then made the contract for them—certainly 10 per cent. lower than we should have procured them, simply because the makers knew that Mr. Parkes was well aware at what price they could be afforded, and was prepared, in case of necessity, to establish a tilery, as he had previously done on estates in several counties. Pipes, tools, and spademen being at length provided, Mr. Parkes brought a foreman, with whom he set out drains, and left the work under his superintendence. To this man we paid 20*s*. per week. He understood pretty accurately the prices of work, and dealt fairly between the employer and the labourers. He instructed them in the use of the new tools. He measured up the work, kept the accounts, paid the men, and *laid every pipe and collar with his own hands*. It would be scarcely more absurd to set a common blacksmith to eye needles, than to employ a common labourer to lay pipes and collars. For these services we paid to Mr. Parkes 5*s*. per acre drained, and some travelling expenses. In each of the two years preceding that on which we had Mr. Parkes's assistance, we drained similar and adjoining land. We do not believe that Mr. Parkes would have varied either the direction or the depth of any of our drains. He would have made them less frequent—intervals of 12 yards instead of 10, and 10 instead of 8. Allowing for this, we find that the saving on Mr. Parkes's draining, after it is debited with every charge, is more than 10*s*. per acre. We verily believe that, in the case of a totally-inexperienced land-owner or bailiff, the saving would be reckoned by pounds, not by shillings. Our readers will expect that we should say something about cost. We do not think that we ever saw so favourable a combination of circumstances, that efficient thorough-draining of retentive land could be executed, at from 4 to 5 feet deep, under 4*l*. per acre. We have seen few or no cases in which it might not be executed for 5*l.* The minimum price for excavating and refilling a 4-feet 6-inch drain is, according to our experience, 1¼*d.* per yard. This low price is generally in those clays which require the most frequent drains. The maximum, 2½*d.*, except in cases where there is actual rock. The frequency with which the pickaxe is used is nearly an accurate measure of the necessary advance of price.

Our parting word shall assure our readers, that every reported case of failure in draining which we have investigated has resolved itself into ignorance, blundering, bad materials, or bad execution.

POSTSCRIPT.

SINCE the substance of this Essay was first published, a dry March has afforded us the opportunity of investigating accurately the effects of some drainages executed in the manner which we have recommended. In the winter of 1846–7 we drained a portion of an old forest which had never received any culture—drains 4 feet 6 inches deep, in the line of steepest descent, parallel, 9 yards apart, the conduit formed of 1 inch and 1¼ inch pipes collared, the shape of the land a regular plane, with an inclination of about 1 inch in a yard. Six inches of light brown moderately friable soil on a *very* retentive clay, which passed at 4 feet deep into a somewhat opener clay or marl. Surface before drainage plashy in wet weather, and covered with a fuzzy grass, blue in summer and white in winter, on which no animal would willingly graze, and barely worth, to let, 5*s.* per acre. In the first summer after drainage the herbage was visibly improved. In the second autumn the cattle grazed it bare. During the second winter it was covered with a dressing of lime and soil, at an expense rather under 5*l.* per acre. In this the third summer it has a very good herbage, and any neighbouring farmer would give for it, to graze only, 25*s.* per acre. We consider the expenditure on this land to have paid about 10 per cent. At the end of a dry fortnight in March we sunk a trial-hole, 6 feet long, 2 feet wide, and 5 feet deep, in the direction of the drains, and at the intermediate point between two. The water in the hole stood at 4 feet 3 inches from the surface, or 3 inches above the bottom of the drains. During a fortnight which passed without material rain, the level of this water-table was not perceptibly varied. A pash of rain then raised it about 6 inches, but four dry days reduced it to its previous level. Every face of the trial-hole was a net-work of cracks. We consider this draining to have done its work effectually; and we had the pleasure of showing this trial-hole to two considerable land-agents, who had previously doubted the efficiency of 4-feet draining in very retentive land. Early in the autumn of 1849 we drained land very similar to that just mentioned, and similarly in all respects, save that the drains were 12 yards apart. Simultaneously with the trial-hole above mentioned, we sank three of the same depth, dimensions, and direction at points, 4, 5, and 6 yards respectively from one of these more recent drains. The water stood in these holes at 2 feet 2 inches and 2 feet 3 inches from the surface, and during the dry fortnight sunk from 1 inch, decreasing regularly, to half inch per day. The pash of rain above mentioned raised this water to within 15 inches of the surface. It then subsided in a ratio diminishing from 1½ inch to half inch per day, till, by the crumbling of the sides, and consequent puddling of the bottom, these holes lost their experimental character. This trial confirmed our previous experience, by showing that retentive land deep drained does not effectually part with its water till a considerable period of drought, heat, and perhaps vegetation, has passed over it. Our third investigation was on land of nearly the same character and slope as those which we have named, differing, however, in that it was overhung by a hill rising at 5 or 6 inches in the yard to the height of 50 feet, the rise terminating in a plain of some extent. The steep ground had a subsoil of semiporous marl, was not drained, and showed little sign of wet. The drains in the lower land were in the line of its descent, and were driven well into the point where the steeper rise commenced. In this ground we sunk four trial-holes at points equidistant from the drains, and in their direction. The appearances disclosed by three of these holes were not satisfactory. The water-table was less lowered than in the previous case, and even after they had been opened and exposed to a dry wind for some days, their faces, and that which fronted the hill in particular, remained dark and damp, and water was evidently squeezing through them. In the fourth trial-hole the water-table stood several inches lower than in the other three, and all its faces exhibited the cracked appearance which is usual in well-drained land. About 3 yards from the upper end of this fourth trial-hole a deep drain passed between it and the hill. The inevitable conclusion appears to be, that, in land so situated as we have described, some sort of cutting off drainage is essential to a perfect cure. A single deep drain passing under the hill, at the point where the steeper rise begins, may not be effectual, because, whenever its depth (be it 4, 5, or 6 feet) is exhausted by the fall of the land, the water from the higher ground having passed under it will appear at the surface. We are about to drain some land similarly circumstanced, and we have set out the drains in the direction which a collier expressively calls half-rise, bisecting the right angle formed by the line of steepest descent and the horizontal line. We hope by this compromise to secure, with respect to every portion of the land drained, most of the advantages of a drain in each of these directions.

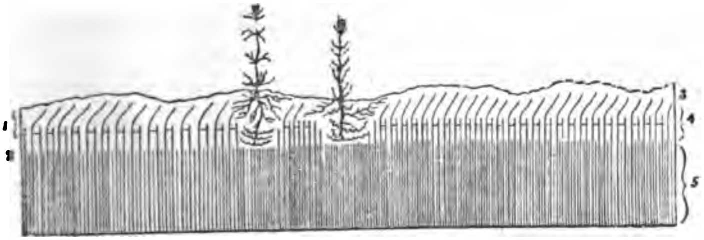
The late Sir R. Peel took an interest in the reprint of this Essay. On the morning of the day on which he made his last speech in the House of Commons, he addressed a letter to us on the subject of the reprint. We cannot, indeed we know not why we should, deny ourselves the gratification of quoting from his letter the following testimony—"I do not think that the article admits of improvement by addition, certainly not by omission." Sir Robert then suggests that drawings of some of the necessary draining tools should accompany the reprint. We have selected from a sheet of patterns, furnished to us by Mr. Walter Adams Lyndon, of Birmingham, those tools without which, in our opinion, 4 or 5-feet drains cannot be neatly or economically executed.

A suggestion made by Sir R. Peel in the letter to which we have referred, will carry most weight if given in his own words: "Many of those who drain extensively neglect to have *a plan* of the draining of each field made at the time that the work is done. A hint as to the advantage of this might be advisable." The plough soon obliterates all superficial traces of the drains; and we know by experience how soon every one concerned either forgets, or remembers very inaccurately, their precise position.

The very inappropriate and unpleasing name of cesspool has been given to a device for securing at all times an easy inspection of the working of drains, at points in their intermediate course. At the confluence of two or more drains, or at any suspicious point in an important drain, a perpendicular drop of 2 or 3 inches is made in the floor, and (as we have seen at Drayton Manor) an earthenware article, of length proportioned to the depth of the drain, and shaped like a chimney-pot, is introduced. It is made with such holes as may be requisite for receiving the nose of a pipe from each delivering-drain at the higher level, and the nose of the discharge-pipe at the lower. In lieu of the chimney-pot, a hole a foot square, bricked up (with the same arrangement of the noses of the pipes) to the surface of the ground, will answer the same end. The top in either case may be covered with a stone flag or wooden lid. Lift up the lid, and a glance shows you whether the drains concerned are doing their duty. These peep-holes are very cheerful things. Nothing gladdens the heart of an agriculturist more than to see his drains running merrily. In permanent grass they may be placed anywhere, and some unobtrusive corner can generally be found for them in arable land. We finish with masonry every important outfall, and consider the few shillings which this costs one of the most satisfactory items in our drainage expenditure.

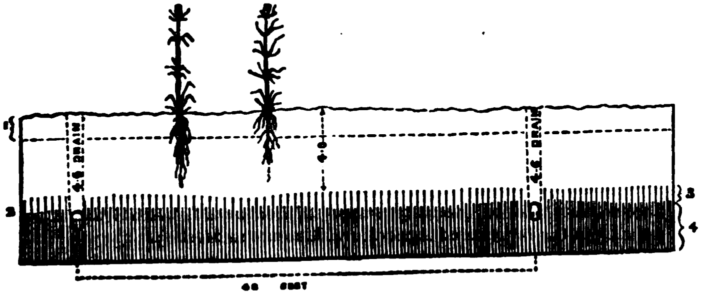
July 20, 1850.

No. 1.—*Section of Land before it is Drained.*



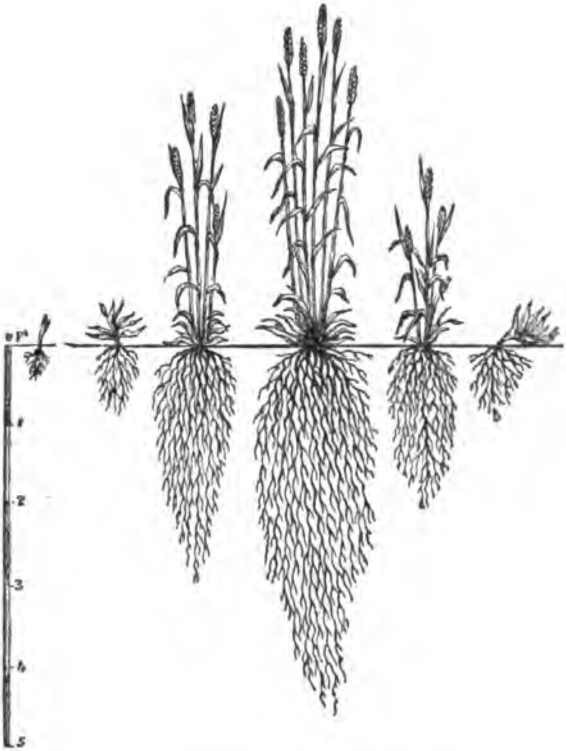
1. Surface Soil.
2. Water-Table.
3. Water of Evaporation.
4. Water of Capillary Attraction.
5. Water of Drainage, or Stagnant Water.

No. 2.—*Section of Land after it is Drained.*



1. Surface Soil.
2. Water-Table.
3. Water of Capillary Attraction.
4. Water of Drainage, or Stagnant Water.

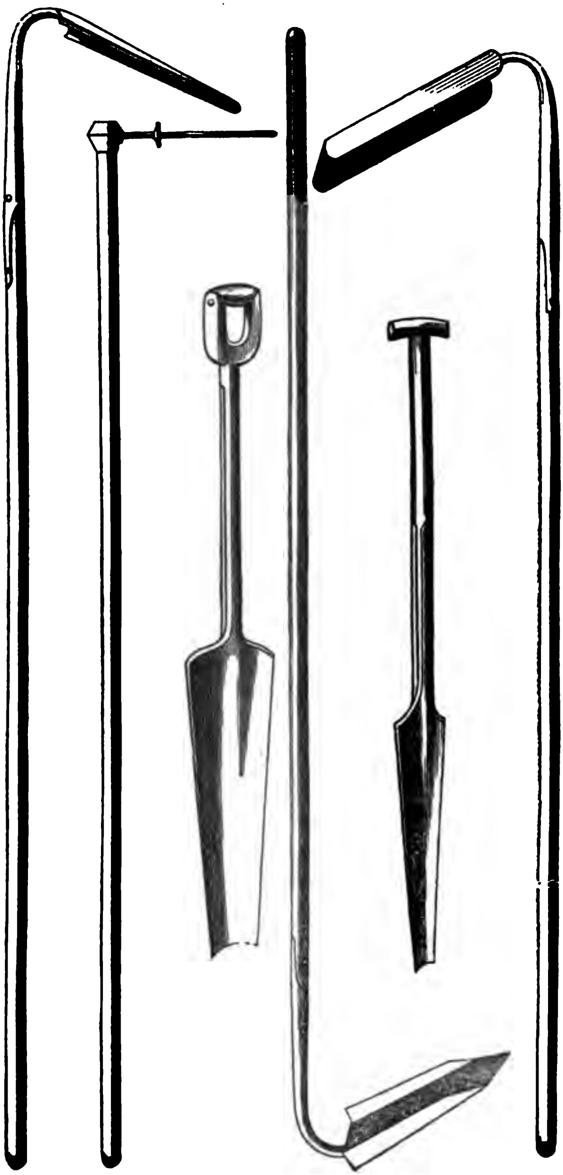
No. 3.



SKETCH OF THE WHEAT PLANT

at different periods of Vegetation, showing the depth to which the fibrous roots can be generally traced in free mould, taken from a drawing in the Drummond Agricultural Museum in Sterling.

DRAINING IMPLEMENTS.



ANCIENT

AGRICULTURAL LITERATURE.

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ANCIENT
AGRICULTURAL LITERATURE.*

EARLY in the eighteenth century Adam Dickson was born at Aberlady in the county of East Lothian. His father followed the profession of theology and the practice of agriculture, and brought up the son to his own pursuits. A liberal education at the University of Edinburgh qualified him for the former, and experience on his father's large farm, aided by intercourse "with the farmers of that opulent county, who are many of them not unfit to converse with men of letters," made him an adept in the latter. He was, says his biographer, "a man of a very lively apprehension, of an ardent mind, and of a clear and sound judgment." In 1750 he was ordained minister of Dunse in the shire of Berwick; but even at that early period the anticipatory growlings of the storm which was destined a century later to rend the Kirk of Scotland in twain, were now and then heard, and an opposition to his settlement was raised among the parishioners of Dunse. Such, however, were "the ability, good sense, and engaging temper of Mr. Dickson, and such the candour and generosity of his conduct, that his most sanguine opponents soon became his greatest friends." Having thus happily surmounted his ecclesiastical troubles, he had time to turn his attention to the spirited exertions which were at that period overcoming, in the county of Berwick, much greater difficulties than had been encountered by the improving agriculturists of his native shire. For several years he vexed his agricultural soul with the books of husbandry which had been published in England, and which "were ill calculated for the soil and climate of Scotland." Moreover, "many of them consisted chiefly of uncertain speculations on theories not well supported by the history of facts." By these circumstances and considerations Mr. Dickson was led to "select for himself a corner of literature for which the habits of his life had peculiarly qualified him." In the year 1764 he published the first volume of a "Treatise of Agriculture," and the second some years afterwards. With this treatise we, with some compunction, acknowledge ourselves to be entirely unacquainted, and must therefore accept the assurance of Mr. Dickson's biographer, that it "has ever since been held, not only to be the book best adapted to the practice of the Scottish farmer, but, upon the whole, one of the most judicious and practical treatises on the subject ever published in Britain." Soon after the completion of this his first work, Mr. Dickson was translated from Dunse to Whippingham in East Lothian, and there he spent the last six years of a life which was accidently terminated by a fall from his horse. During that period he prepared for publication, "by years of anxious study," a work of considerable interest, of which we propose to give some account to our readers.

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* "The History of Agriculture in Ancient, Mediæval, and Modern Times." By Chandos Wren Hoskyns, Esq. 12mo., 1849.

The two branches of Mr. Dickson's education qualified him better than most men who either preceded or have followed him, to trace the analogy between ancient and modern agriculture, and to supply the connecting link. In 1788 this work was printed in Edinburgh by Mr. Dickson's representatives, under the auspices of the then Duke of Buccleugh, in the form in which the materials were left by their author; painfully deficient in the curtailment, condensation, and arrangement which they would have received if he had superintended their publication. The mere omission of duplicate, triplicate, and quadruplicate long quotations from ancient authors, accompanied at each repetition by a diffuse translation and commentary, would reduce "The Husbandry of the Ancients" from two volumes to one. To the anonymous editor we are indebted for nothing but a very common-place dedication, and a meagre account of Mr. Dickson contained in six pages.

Agricultural literature occupied a far higher position among the ancients than it has hitherto attained in our day. A mere enumeration of the names of those authors whose works remain, and the testimony which many of them bear to the merits of Mago the Carthaginian, whom they declare to have been the father of agricultural literature, will leave no doubt on the question of precedence. To Hesiod, Theophrastus, Xenophon, Cato, Varro, Virgil, Columella, Pliny, and Palladius, whom have we to oppose? A few notices of agriculture may be found in Lord Bacon's works, and Sir H. Davy wrote an agricultural book, which was by no means one of his most successful efforts; and here, as far as we know, our first class must end abruptly. We are not insensible to the merits of Arthur Young and Jethro Tull, but we can hardly put them on a par with Cato and Pliny; and we doubt whether we could not even now farm more successfully by following the directions of the two ancients than of the two moderns. We have a few pastoral and bucolic poets to whom we must oppose Theocritus and Homer, who are not included in our former list, and who are infinitely superior to any of them, with the single exception of Hogg, as practical shepherds, neatherds, and swine-herds. Nor is a study of these old writers a mere matter of fancy. We could take up almost any one of them and begin with him the agricultural year—prepare the field—sow the crop—weed it—reap it—harvest it—thresh and winnow it—ascertain the weight per bushel, and the yield in flour or meal—market it—buy, feed, clothe, and lodge the agricultural slaves—purchase, rear, and sell the cattle and fowls—collect and prepare the manure—and make out, at the end of the year, a more accurate balance-sheet than could be furnished by half the farmers in Great Britain. For all this we are mainly indebted to Mr. Dickson. The agricultural writers had received their fair share of criticism ; but it was not likely that passages which were rendered obscure by obsolete names and technical phrases would be elucidated by scholiasts and commentators—albeit doctors and professors *eruditissimi necnon illustrissimi*—to whom a modernised version would have conveyed a very imperfect idea, on account of their total ignorance of the art which was the subject of discussion. Philology could not elucidate the operations of the "vervactor" and "imporcitor" to Madame Dacier, nor could the Muse explain to Mr. Martyn the connexion between the "buris" and the "stiva." Mr. Dickson thus alludes to some of his controversies with these profound men :—

"As all the commentators explain the passages concerning ploughs in a sense different from what I have done, it is with great diffidence that I deliver my opinion. At the same time I use the freedom to observe, that it is not in the least surprising that the whole class of commentators should go wrong in a matter of this kind, as there are none of these learned persons that seem to have given themselves the trouble to acquire any knowledge of the nature and construction of ploughs, or of the various uses of the several parts."

He himself brings to his task competent classical knowledge, an intimate acquaintance with the existing practices of agriculture, and abundant zeal and industry. Nothing, however, can exceed the dulness of his dissertations. For instance, eleven dreary pages, and the collation of more than thirty passages from Cato, Varro, Virgil, Columella, Pliny, Saserna, and Palladius, will convince the persevering reader that the "vimineæ crates" mentioned in the first Georgic were not, as "the learned commentator Popma," in his controversy with Servius, supposes, dung-carts, but clod-crushers; and that the "rastrum" of Columella and others was identical with the "quadridens" of Cato, and was the implement used by the "occator." Dickson appears to us to have generally succeeded in making out his point, though in some obscure passages he seems rather to have been determined to make a meaning than to have succeeded in finding one, and in those cases he is not very scrupulous about altering the text of his author. On the whole, however, he has evolved an intelligible and consistent system of agriculture as pursued by the Romans, and has brought before us some incidental but very interesting notices of the modes of cultivation practised in Greece, Sicily, Gaul, and Britain. The Reverend thresher has beat out the grain, but has left it jumbled up with the straw and chaff in one confused heap, which we will endeavour to reduce into more marketable dimensions. But before we do so we must shortly notice the more recent labourer in the same field, Mr. Wren Hoskyns. This author ventures on a far larger range than his predecessor; and though his book only consists of 160 very small pages, he finds room for a great deal of mild moralizing, and for many and rather ambitious dissertations, which have no very close connection with the "History of Agriculture in Ancient, Mediæval, and Modern Times."

Mr. Hoskyns is evidently a well-informed and accomplished man. He appears to have a genteel knowledge of practical agriculture, though in that respect he cannot be compared with our hard-handed pastor. The persevering reader will have to follow him through page after page of simple reflections, very nicely got up and prettily worded, without encountering a syllable of which he can disapprove. It is a relief to find something to deny—or even to doubt; and we present the following passage as a favourable specimen of Mr. Hoskyns's more adventurous flights. Though we are not prepared absolutely to contest its doctrine, Cicero and Seneca certainly rise to our minds as stumbling-blocks in the way of our according to it an unqualified assent:—

"If one may be allowed the reflection, agriculture *ought to have been* carried to greater perfection by the Romans than by any other nation. The habits of the farmer's life do—at least as far as all experience hitherto has gone—to a certain extent indispose the mind for an abstract idea. This was a marked want in the mental constitution of a Roman. When Pilate asked *What is truth?* he put a question which might be cut upon brass or adamant, to stand for ever as the characteristic question of a Roman. The first blunder of every English schoolboy, in his early attempts to translate English into Latin, is his natural and simple attempt to give a direct rendering of abstract terms from his own language into the other. Even the word *action*, the most energetic, perhaps, of abstract terms one could select at hazard, he would unconsciously endeavour to express in Latin by a word which, to every Roman ear, would mean a *sea-fight* or a *suit at law*. An abstract idea was nonsense to a Roman; a *true* story, a *true* book, or a *true* man would at once have found a place and a recognized meaning in his understanding. But when the Roman asked, *What is truth?* the question was not particular, but generic: it applied to the whole catalogue of abstract ideas; to that entire department of the human mind which is able to reflect *upon itself*, and express *thought* separate from objects."

We must confess that this goes beyond us. Two and two are four. No idea can be more "abstract," no thought can be more "separate from objects." Does Mr. Hoskyns really mean that this idea was "nonsense to a Roman"?

The only portion of ancient agriculture with respect to which Mr. Hoskyns gives us any material information that is not contained in Dickson's work, is that of Egypt. Even that section, however, comprises nothing more than the ordinary Scriptural allusions, a reference to Egyptian remains in the British Museum, a dissertation on hieroglyphics and on the origin of alphabets, and a long quotation from Pliny, descriptive of the rise and subsidence of the Nile, and of the agricultural operations consequent thereon.

Our knowledge of the subject in question has not only been confirmed, but also very much enlarged, of late years. The notices of it which occur in Diodorus, Strabo, Pliny, Plutarch, and other writers, have been brought together by Sir Gardner Wilkinson in the first volume of the second series of his "Manners and Customs of the Ancient Egyptians." They receive a most interesting illustration from the drawings which this distinguished traveller and his fellow-labourers have brought to light from the tombs. Not only is the manner in which these men of old performed the operations of husbandry placed strikingly before our eyes, but we are admitted at once into the penetralia of the economical, and, we might almost say, moral management of a farm. The owner, attended by his faithful dog, watches the work; the scribe or clerk, with his desk and double stand, containing black and red ink, receives and records the tale of corn, cattle, poultry, and even eggs; the labouring men and beasts plough, sow, reap, thresh, winnow, are rewarded and punished; and, finally, the despised neat-herd leads before us an ox, one of Pharaoh's fattest kine, whose fair proportions are, no doubt, intended to be a satire on the deformity of his attendant. Our enumeration contains less than one-half of what is vividly portrayed. Sir Gardner, intimately acquainted with present Egypt, traces in many instances the analogy which exists between ancient and modern practice. Most of our readers are probably acquainted with his work; those who are not have a rich treat in store.

We can hardly suppose that Mr. Hoskyns was ignorant of Dickson's book, which has been frequently quoted in the "Royal Agricultural Journal" and other kindred publications. We think that some recognition of the labours of a predecessor, who probably very much lightened his own task, would have been no more than a graceful tribute. Mr. Hoskyns's mediæval and modern dissertations are foreign from our present purpose. He has a long passage on the application of steam to the *cultivation* of the soil, and expresses a strong opinion that the hitherto-failures have resulted from a misdirection of the power. A steam-engine, he says, should dig, not plough. We are told that digging is a very satisfactory, ploughing a very unsatisfactory, operation. We read on the tiptoe of expectation, hoping to learn how a steam-engine shall be made to dig; but Mr. Hoskyns cruelly passes on to determine how much coal would lift a man from the valley of Chamouny to the top of Mont Blanc. We have been obliged to qualify our praise of Mr. Hoskyns's book, which is, however, by no means uninteresting; indeed, we rather think it is suited to a considerable class of non-agricultural readers.

Before we return to our more homely instructor, who occupies himself almost wholly with Roman husbandry, we must despatch, in a few sentences, the little information which we have been able to gather on Grecian and Carthaginian agriculture. Though Attica was arid, Laconia swampy, Megara rocky, and Corinth dependent on importation for a supply of food, the art of the husbandman was not without its literature. Pliny laments over forty Greek treatises on agriculture, which were lost in his day; and Columella reckons them at fifty. The pursuit may not have been held in high esteem, but its operations were certainly familiar to the educated class. Hesiod was strictly an agricultural writer; and the allusions to farming operations in Homer and Theocritus are definite, and entirely practical. Eubœus, συβώτης ὄρχαμος ἀνδρῶν, is no fanciful swine-herd; and, however ideal the ditties of Lycidas and Thyrsis may be, their shepherding is quite real. In the passage relating to the capture of Dolon, Hector's spy, Pope, following Madame Dacier, has made a sad hash of a simile which is perfectly plain to those who understand the proprieties of ploughing. In the agricultural compartment of Achilles' shield, we see before us no poetical field, but a deep loamy fallow, the texture and colour of which indicate that it is receiving its third furrow; and in the crop of grain which is falling before the sickle, we have an accurate division of labour which a Norfolk farmer might do well to imitate:—

> βασιλεὺς δ' ἐν τοῖσι σιωπῇ,
> Σκῆπτρον ἔχων, ἑστήκει ἐπ' ὄγμου γηθόσυνος κῆρ.

This must have been in the palmy days of protection. Probably few of our living poets would be capable of giving, and as few of their readers of appreciating, so detailed an account of the simplest farming operations. These notices of agriculture in Herodotus and Thucydides are only incidental; but a work by Theophrastus, which has descended to us, is by no means, as Mr. Hoskyns intimates, a mere "botanical catalogue of plants." It contains many useful practical directions, and frequently discriminates, with much accuracy, between the modes of husbandry suited to different countries and climates.

Xenophon is said to have bought and occupied a farm near Smyrna, where he wrote the agricultural treatise commonly called his Œconomicks, and which is frequently appended to the Memorabilia. It treats of farming, gardening, and household management, under which last head it gives valuable instructions for the government of wives. Cicero praises this treatise highly. It contains the passage in which Cyrus the younger exhibits hinself to Lysander as 'The Persian Farmer;' "ut intelligatis," says Cicero, "nihil ei tam regale videri quam studium agricolendi."

The few notices which we possess of Carthaginian agriculture are singular, and scarcely reconcilable with each other. Heeren reckons the fertile provinces of Carthage in Africa to have been about equal in area to Ireland; and divides the remainder of their African territory between

Nomad tribes and Lotophagi. It appears from Diodorus, Polybius, and Strabo, that the Carthaginians received large supplies of grain from Sardinia and Sicily. Heeren, of whose research and judgment it would be impossible to speak too highly, says:*

"The foreign colonies of Carthage were always chosen for the purposes of commerce; but those within her own territory were, at least for the most part, inland, and fixed upon for the promotion of agriculture. . . . . It was a general principal of Carthaginian policy to improve, as much as possible, the cultivation of their lands, and to accustom the native tribes under their subjection to do the same. . . . They, in fact, appear to have attached more importance to agriculture than to commerce. . . . . . It is plain that families of the first rank were in possession of large estates, from whose produce they drew their income; while on the contrary, there is not a single trace, in the whole history of the republic, of their being concerned in trade."

It is difficult to reconcile these opinions of Heeren's, with Cicero's statement that a preference for trade and navigation, and a neglect of agriculture and arms, were the main causes of the weakness of Carthage.† The modern, however, derives much support from indisputable facts relating to Carthaginian literature. Kings, or perhaps presidents, but at all events great generals, were among their agricultural writers. "Mago the Carthaginian and Hamilcar (says Columella) held it not beneath their dignity, when they were unoccupied by war, to contribute by treatises on farming their quota towards human life." We learn from several sources that the books of Mago on agriculture amounted to twenty-eight; that they were translated into Greek by Cassius Dionysius of Utica; that on the final destruction of Carthage, when the whole literature of the conquered nation was given over by the Romans to their

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* We quote from the translation published at Oxford in 1838.

† De Republicâ, 2. 4.

African allies, these twenty-eight treatises were considered so valuable, that they were specially excepted, brought to Rome, and by the senate ordered to be translated at the public expense. Pliny says that D. Silanus, belonging to one of the first families, surpassed the other translators. They are treated as of great authority by Varro, Columella, Palladius, and Pliny; and in the appendix to Heeren will be found thirty-one distinct passages in which the maxims of the Carthaginian author are handed down to us. It is singular enough that no one of these passages has any reference to the cultivation of any species of grain. One passage gives directions for the grinding or pounding of maize, barley, lentils, vetches, and sesame. Another strongly recommends landed proprietors to be resident—"He to whom an abode in the city lies close at heart, has no need of a country estate." The directions for culture apply solely to vines, olives, the nut tribe, poplars, and reeds. We unfortunately do not learn the structure of his humanity-hives, but it appears that he disapproved of destroying the bees when the honey was taken. Columella vouches, on personal experience, for the excellence of the Punic receipt for making the very best wine, "passum optimum." Farriery (including the symptoms of broken-wind in horses, and a prescription,) a critical operation to which male animals are subjected, and the gestation of mares and female mules, are all brought under review; and we have the astounding statement, that in Africa the latter females were nearly as prolific as the former. This is more surprising, because Cato, who died before his "Delenda est Carthago" was fulfilled—and accordingly shows no acquaintance with Mago's writings—makes the same assertion. "Upon the health of black cattle," says Varro, "I have borrowed a good deal from the books of Mago, which I make my herdsmen carefully read." And not only does the Carthaginian treat of the health of cattle, but he gives directions for buying oxen for the plough, so precise that they will perhaps interest our readers Both Heeren and Dickson have translated the passage, but as each appears to us to fail in giving the precise meaning, we have ventured on a translation of our own:—

"The young oxen which we buy should be square in their form, large limbed, with strong, lofty, and dark-coloured horns, broad and curly fronts, rough ears, black eyes and lips, prominent and expanded nostrils, long and brawny neck, ample dewlaps pendant nearly to the knees, a wide chest and large shoulders, roomy-bellied, with well-bowed ribs, broad on the loin, with a straight, level, or even slightly-depressed back, round buttocks, straight and firm legs by no means weak in the knee, large hoofs, very long and bushy tails, the body covered with thick short hair of a red or tawny colour, and they should be very soft handlers (*tactu corporis mollissimo*)."

Palladius gives directions in nearly the same words, without however intimating that he derived them from Mago—a very tidy ox, whether he be purchased in Libya in the year B.C. 600, or in Northamptonshire A.D. 1850. More than one Mago figures in Carthaginian history, but the agricultural writer is supposed to have lived in the time of Darius, and to have been the founder of the great Punic family from which Hannibal sprang.

Of the Roman agricultural writers Cato claims precedence as first in time, and first in honour. The Censor died, aged 88, in the year 150 B.C. He is treated with great deference, and is much copied by most succeeding authors on the same subjects. He was a practical husbandman, having inherited from his father a Sabine farm. In his writings he recommends careful and precise, but by no means high farming. Most of his maxims tend rather to a limitation of outlay than to active improvement; and he falls under the lash of Plutarch, for having heartlessly recommended the sale of worn-out oxen and slaves. Whenever Cato rises to our mind's eye, it is in the form of our venerable friend Joseph Hume. Had we an historical painter, our financial reformer ought to sit to him for the figure of Cato denouncing to the senate the extravagance of Scipio's camp. "In parsimoniâ," says Livy, "in patientiâ laboris, ferrei prope corporis animique: quem ne senectus quidem, quæ solvit omnia, fregerit." We are far, however, from insinuating that a future satirist will have occasion to say—

"Narratur et prisci Josephi
Sæpe mero caluisse virtus."

Two Sasernas (father and son) lived between the time of Cato and Varro, and wrote on agriculture. Their works have not descended to us; but they are quoted as of acknowledged authority by all the succeeding writers.

Varro, "Romanorum doctissimus," lived through nearly the whole century which immediately preceded the Christian era. He was one of Pompey's generals and admirals, and was subsequently librarian both to Julius and to Augustus Cæsar. His own very valuable library was wantonly destroyed by Anthony. He was a very voluminous writer, but a philological treatise, and his "De Re Rusticâ" are all that remain to us. The latter work was written when he was eighty years of age, and is in the form of a dialogue. It is in three parts, and is dedicated to his wife. He was a practical agriculturist, and frequently refers to the operations on his own farm, but he relies principally on the authority of Mago, and some Greek writers. The work is by no means servilely rustic, but diverges from time to time into mythology and ethics.

Some fascinating sentences in the "De Senectute" hardly warrant our placing Cicero among the agricultural writers Though they display some practical knowledge, they relate rather to the amenities than to the labours of husbandry. In his opinion "vita rustica parsimoniæ, diligentiæ, justitiæ, magistra est" (*Pro Rosc.*); "aratores" are "id genus hominum quod optimum atque honestissimum est." (*In Verr.* 2.) Agriculture, with him, is rather an honour to princes, and the ornament and solace of declining age, than a painful struggle with thorns and thistles brought forth by the ground, which yields bread to man "in sorrow" and in the "sweat of his face."

Of the Georgics we need only say, that they afford not the least striking instance of the exquisite skill with which the Roman poet could borrow more than a foundation, and rear on it a structure possessing all the charms of originality. Perhaps, none but an agricultural reader will fully perceive the perfect harmony which is maintained in the Georgics between the imagination of the poet, and the homely science of the farmer. The two characters never clash. Whenever the farmer comes on the scene—however smooth the verse and elegant the diction—the directions which he gives are precise, ample, practical, and sound. The poem becomes a hand-book of husbandry. Virgil (born B.C. 70) succeeds Varro in the catalogue of agricultural authors.

Columella usually personates the classics of agriculture, and horticulture, to our imagination: partly perhaps because his works have come to us nearly entire and in large volume; but principally, we think, because we know him merely as an agricultural writer, whereas most of his rivals or coadjutors are familiar to us as kings, generals, statesmen, orators, philosophers, or poets. He was a Spaniard, and apparently born about the time of the Christian era. He occupied a Pyrenean farm, and speaks more largely of his success in cultivating the vine, than in any other department of husbandry. He introduces to us an uncle of his own name as an eminent flock-master, who much improved his sheep by introducing rams from Africa. We suspect that on this statement is founded the popular opinion, that Columella established the Merino sheep in Spain. Columella makes free use of the agricultural writers who preceded him, particularly of Mago, to whose authority he submits with willing deference. Among the Latin authors whom he cites with respect, is Julius Græcinus, the father of Agricola. Columella's work is divided into twelve books—two on farming and farm-premises—but which contain also some directions, partly moral and partly physical, on the selection and management of agricultural slaves: three on the vine, olive, and orchard fruits—two on agricultural and domestic animals, from which, on prudential grounds, he excludes the sporting-dog—one on poultry—one on bees. In the 9th book he attempts, with small success, the supplement to the Georgics which Virgil indicated:—

> "Verum hæc ipse equidem spatiis inclusus iniquis
> Prætereo, atque aliis post me memoranda relinquo,"

and breaks into verse on the subject of gardening. Three more books treat of the bailiff, his wife, wine, vinegar, jampots, and the kitchen garden.

Pliny died A.D. 79. His contributions to the agricultural library are a small portion of the great work which he has left as a monument of his industry and research. We have no reason to suppose that he had any personal knowledge of agriculture. He was in that instance, as in many others, a diligent, but not always a discriminating compiler. Of the elder authors, to whose own works we can still refer, he uses most freely Mago, Cato, Varro, and Virgil. He speaks of Columella, but for the most part slightingly.

Palladius published A.D. 355 He was a landed proprietor in Sardinia, and also near Naples. He wrote fourteen books of a farmer's calendar, and a poem on the art of grafting. He seems to have been rather a servile copyist from the older writers, but his work was much esteemed in the middle ages, and was translated into English, in 1803, by Thomas Owen.

Thus we have before us a series of literature, devoted to one object, extending over eight, and in the Roman department alone over five centuries. No one can wade through the whole mass without observing the striking fact, that neither at the end, nor during any part, of the series does agriculture present itself as a progressive art. We are introduced to no improvements, to no newly-invented implements: we are told of no practices abandoned as obsolete or superseded. We find, with the single exception of lucerne (and perhaps cytisus), no new object of culture. From Cato to Palladius the same routine is prescribed, and generally in the same terms. Their most refined practices—those in which they made the nearest approach to a successful application of mechanical power—may be traced in the historical books of the Old Testament, and in the prophets. We encounter a few prudential and very cautious maxims about trying experiments; but we are told of no fruit (if there be an exception, it is in the case of vineyards); and as we work down the series we meet with increasing complaints of diminished produce, and declining profits. The characteristics of Roman agriculture, as described in the books, were—system, accuracy, and great vigilance against waste. It was careful, painstaking, garden-like farming, with very few artificial or adventitious aids. We exclude, altogether, from our consideration the degraded period when Roman farms were screwed down to 4 acres (7 jugera) apiece. This state of things—if indeed it ever existed—was social, not agricultural. The story of Attilius Regulus, who, having heard—while he was pursuing a career of conquest in Africa—that the bailiff of his 4 acre estate was dead, and that his farming slave had run away, immediately sent to the senate a catalogue of his spades, hoes, rakes, and spuds, and informed them that, unless they took these implements into their special care, and procured for him another bailiff and another slave, he should leave the command of the army and come home to look after his property, is very amusing, but is of no agricultural import, unless it be at O'Connor Ville or Sniggs End. But, when the Romans got wiser, in our estimation, though worse perhaps in that of M. Louis Blanc, farms took the size which was adapted to the convenience of culture. Farming which was carried on without expensive implements, and without powerful machinery, did not offer the inducements which now exist to large holdings. Probably 62½ acres (1 plough,) or 125 acres (2 ploughs) of arable land, could be cultivated as economically as a larger breadth.

Before we describe the Roman course of culture, we must say a few words on their system of occupation. In this we find a progressive change, and a constant approximation to modern practice. The first definite accounts represent proprietors residing on their own lands, and joining personally in all the labours of agriculture. Called off from time to time to war, or council, when the demand for their public services ceased, they returned to their homely occupation. Before the time of Cato, however, the habitual residence of the proprietor had become more rare. The claims or the attractions of Rome and other cities prevailed, and the farmhouse (villa) was delivered over to the custody of the bailiff (villicus); pleasant and even luxurious apartments being reserved for the occasional occupation of the owner. Cato gives directions suited to this state of things, of which Varro and Columella make whining complaints, intimating that, in their day, Roman land-owners were more inclined to hold up their hands in the circus, and theatre, than to apply them to the plough and pruning hook. Though one passage from Cato is rather long, we hope that those of our readers who are acquainted with it will not be sorry to have it brought back to their recollection; and that those who are not will be interested by it as we have been ourselves. We are again obliged to discard Dickson's translation:—

"When the proprietor arrives at the villa, and has paid his respects to the household gods,* he should, if he possibly can, go round his farm on that day; if he cannot do that, certainly on the next. When he has completed his own inspection, on the morrow he should have up his bailiff, and inquire of him what work has been done, and what remains to be done—whether the work is sufficiently forward and whether what remains can be got through in due season—what has been done about the wine, corn, and all other matters. When he has made himself acquainted with these things, he should then compare the work done with the number of days. If work enough does not seem to have been done, the bailiff will say that he has been very diligent—that the slaves could not do any more—that the weather has been bad—that slaves skulked—that they have been taken off to public work. When the bailiff has given these, and many other, reasons, bring him back to the actual details of work done. If he reports rainy weather, ascertain for how many days it lasted, and inquire what they were all about during the rain. Casks might be washed and pitched, the farmhouse cleaned, corn turned, the cattle-sheds cleaned out and a dung-heap made, seed dressed, old ropes mended, and new ones made; the family might mend their cloaks and hoods. On public holydays old ditches might have been scoured, the highway repaired, briers cut, the garden dug, twigs kidded, the meadow cleared, thistles pulled, grain (far) pounded, and everything made tidy. When the slaves have been sick they ought not to have had so much food. When these matters are pretty well cleared up, let him take effectual care that the work which remains to be done, *shall be done*. Then he should go into the money account, and the corn account; examine what has been bought in the way of food. Next, he should see what wine and oil have come into store, and what have been consumed, what is left, and how much can be sold. If a good account is given of these things, let it be taken as settled. All other articles should be looked into, that if anything is wanted for the year's consumption it may be bought; if there is any surplus it may be sold; and that any matters which want arrangement may be arranged. He should give orders about any work to be done, and leave them in writing. He should look over his cattle with a view to a sale. He should sell any spare wine, oil, and corn, if the price suits. He should sell old work-oxen, and culls, both cattle and sheep; wool and hides, old carts and old iron implements; *any old and diseased slave;* and anything else which he can spare. A proprietor should be seeking to sell rather than to buy."

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* Cato is very precise in this matter. In his directions to the bailiff he expressly forbids him to allow his wife to do "rem divinam," or to employ any one to do it on her account. "Scito dominum pro totâ familiâ rem divinam facere."—c. 143.

Cato would have been invaluable as master of an Union workhouse.

The next phase of occupation was called "Politio." The politor or partuarius was a resident working partner, bringing no capital into the concern, but receiving, as his remuneration, a stipulated share of the produce. His proportion of grain varied from one-ninth in the best land, to one-fifth in the most sterile. An elaborate calculation leads to the conclusion that, on an arable farm of 125 acres, a politor would receive from 30 to 35 qrs. of various kinds of grain as his share; but the information does not seem to be of much value, as we are ignorant what privileges of maintenance, for himself or his family, he received from the produce of the farm. It is difficult to ascertain the exact terms of partnership; but it appears that the course of husbandry to be pursued was prescribed by them.

"Liberi Coloni"—*i.e.* farmers paying rent and cultivating wholly on their own account—first appear in the pages of Columella;* and in a passage too long to extract, he discusses the pros and cons of this mode of occupation. He comes to this general conclusion, that a farm never produces so much as when it is occupied by the proprietor: that even under a bailiff, unless he is very rapacious (and taking that word as his text, he enumerates the various modes in which a bailiff can cheat), it will produce more than under the hands of a tenant; but that if it be of that sort on which a tenant cannot commit very great waste, is distant, and not easily accessible to the owner, in that case it had better be let. His rules for the management of tenants are so applicable to all times, that we cannot curtail them, and we give them in Dickson's tolerably faithful, though very clumsy translation :—

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* Cato uses the word Colonus, but it is evident from the context that he indicated thereby not a tenant farmer, but a yeoman resident on his own land.

"A landlord ought to treat his tenant with gentleness, should show himself not difficult to please, and be more rigorous in exacting culture than rent; because this is less severe, and upon the whole more advantageous; for when land is carefully cultivated, it for the most part brings profit, never loss, except when assaulted by a storm or pillagers; and therefore the farmer cannot have the assurance to ask any ease of his rent. Neither should the landlord be very tenacious of his right in everything to which the tenant is bound, particularly as to days of payment. . . . . . On the other hand, the landlord ought not to be entirely negligent in this matter, for it is certainly true, as Alpheus the usurer used to say, that good debts become bad ones by being not called for. I remember to have heard it asserted by Lucius Volusius, an old rich man, who had been consul, that that estate was most advantageous to the landlord which was cultivated by farmers born upon the land; for these are attached to it by a strong habit from their cradles. So indeed it is my opinion, that the frequent letting of a farm is a bad thing; however it is still worse to let one to a farmer who lives in town, and chooses rather to cultivate it by servants than by himself. Saserna used to say, that from such a farm a lawsuit was got in place of rent."

The younger Pliny, in a letter to Calvisius Rufus, discusses the desirableness of purchasing an estate which had been offered to him. He states that it was very much worn out, and was consequently offered to him at a much lower price than that for which it had previously been sold; that it would be necessary to displace the tenants, who were without capital, and had been repeatedly distrained and sold up; and that the investment would pay him 4 per cent., the usual interest on loans being at that period 6 per cent. The standard agricultural sentence about bad times, "communi temporis iniquitate," occurs in Pliny's letter.

We grumble by prescriptive right. Pliny, the ever selfcomplacent orator, advocate, senator, and poet, is a most discontented landowner. His farms are a constant trouble to him:—

"*To Naso.*—A storm of hail, I am informed, has destroyed all the produce of my estate in Tuscany; while that which I have on the other side the Po, though it has proved extremely fruitful this season, yet, from the excessive cheapness of everything, turns to small account."

"*To Genitor.*—Nor is this all; for not only the farmers claim a sort of prescription to try my patience as they please by their continual complaints; but also the necessity of letting out my farms gives me much trouble, as it is exceedingly difficult to find proper tenants."

The desirable size for a farm is discussed by several of the writers, and generally in the prudential spirit of Virgil's maxim:—

"laudato ingentia rura,
Exiguum colito."

Columella prefaces the maxim,—"That the farm ought to be weaker than the farmer,"—by saying that it was "derived from the Carthaginians, who were a very acute people." Palladius says epigramatically, "fœcundior est culta exiguitas, quam magnitudo neglecta." But on this point Pliny is most diffuse—though we believe that Dickson erroneously interprets expressions which Pliny applied to ownership, and not to occupation. When he says—"sex domi semissem Africæ possidebant, cum interficit eos Nero princeps,"—we cannot suppose that half of the province was absorbed by what we should call six farms, and that the bailiffs of these six unfortunate gentlemen were the sole occupiers. He declares, however, by less equivocal expressions, that the ancients were of opinion that it was very desirable to limit the size of farms.* The stories which he tells have also the same tendency as the maxims which we have cited. For one we must find room and a translation :—

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* Nevertheless large arable farms were known to remote antiquity. It may not be safe to found on the numbers in the highly poetical and figurative book of Job; but we learn from a purely historical statement in the book of Kings that Elisha was ploughing with twelve yoke of

"I cannot forbear stating one instance from old times, from which we may perceive both that questions of culture were brought judicially before the people, and also how men of that time were in the habit of defending themselves. C. Furius Cresinus, a freedman, became the object of much ill-feeling on the part of his neighbours, in consequence of his gathering from a very small field much more produce than they could obtain from very large ones. He was accused of attracting the crops from other fields by charms. Sp. Albinus appointed a court day to hear this charge; and Cresinus, fearing that he might be found guilty, when the tribe were about to pronounce their verdict, brought his live and dead farming stock into the forum; and he brought with him a stout wench, and Piso says that she was in good case and well clad. His iron implements were exceedingly well manufactured, the spades were strong, the shares powerful, and the oxen in high condition. Then he said, 'These, Romans, are my charms; but I cannot show you, or bring into the forum, my mental labours, my vigils, nor the sweat of my brow.'"

On the subject of farm-buildings it is difficult to gather much from these writers, principally because, as we have said, they were complicated with the villa, which was, as its name implies, the country abode of the landlord. On this point Cato forgets his usual frugality, and recommends comfort approaching to luxury, with a view of attracting and retaining the residence of the proprietor. Columella is very elaborate on this subject. In the first place, he is fastidious as to situation, both on the score of health and jucundity, and his only prudential maxim is, that a villa should be situated at some distance from a high road, as otherwise all your idle acquaintance will be dropping in

oxen, himself with the twelfth. This, on the Roman computation of 60 odd acres to a plough, would make the prophet the occupier of arable land to the extent of 800 acres.

upon you, and will very much interrupt the business of the farm. In giving the plan of the villa, he is very diffuse on the apartments of the proprietor, the winter apartments, the spring apartments, the summer apartments, and the bath-rooms; and on their respective aspects: the pleasure grounds come in also for a specific notice; but his directions for the "Rustica"—which includes the kitchen, the servants' lodgings, and the stables—and the "Fructuaria," which comprise the oil-cellar and press-room, wine-cellar, hay-loft, granary, &c., are less precise and intelligible. Both Cato and Varro prescribe, in general terms, that the farm should not be too large for the villa, nor the villa for the farm, and point out the inconveniences of each excess; and both give instances of known parties by whom respectively each of these maxims has been transgressed. It is not, however, till we come to Palladius, in whose time tenant farming had become more usual, that we find any directions which are comformable to our notions of a farm-house and buildings. He says that the buildings ought to be proportioned to the value of the farm; and that, in case they were burnt down, the extreme sum allotted to rebuild them ought not to exceed two years' rent: a sum which in our climate would be very inadequate to fulfil our notions of improved agriculture—probably it would not do much more than erect apartments and offices for Mr. Huxtable's pigs.

From the earliest antiquity oxen seem to have furnished the moving power to the plough, though in a single passage, to which we have already alluded, Homer says that in heavy fallow mules are far preferable. As the Romans assigned 60 odd acres to each plough, they assigned to it also 3 labourers, a proportion which did not include vine-dressers, or those who were employed in olive and fruit orchards. A passage in Columella indicates that a portion of the labourers employed on a farm were "soluti, quibus major est fides;" but the bulk were slaves, and they were sometimes worked in fetters, "alligati." The younger

Pliny says that he must let his land because he does not possess "vinctos." Cato and Columella prescribe that the ploughman should be tall, because he will preside with more power at the stilts; whereas short and strong-backed men can do stooping work with more ease. A *bubulcus* should be humane, but have a terrible voice, in order that by it the oxen may be urged to work without being much harassed by the whip or goad. Columella gives the singular direction that if you have any particularly vicious men among your slaves, you should make them vinedressers, because that work requires clever fellows, "ac plerumque velocior est animus improborum hominum." Tallness and strength are of importance in the bubulcus; but of none in the overlooker, who ought to be "sedulus ac frugalissimus." Cato gives a complete dietary for the establishment:—

"For the bailiff, 100 lbs. of wheat per month in winter; one-eighth more in summer.

"For the female housekeeper and shepherd, 75 lbs. each per month.

"For the slaves 4 lbs. of bread each per day in the winter.

"From the time they begin to dress the vineyard, 5 lbs. per day till they have figs, when they revert to 4 lbs."

In addition to this bread the slaves had a restricted allowance of an article called pulmentarium, which appears to have been a dried compound of olives, apples, pears and figs. Pliny says that the name is derived from puls, which was the food of the ancient Romans,—"pulte autem, non pane, vixisse longo tempore Romanos manifestum." When the pulmentarium was exhausted, they had in lieu an allowance of salt fish and vinegar, with a small portion of oil; and each person was allowed rather more than a peck of salt in the year. For three months after the vintage the beverage of the slaves was a weak wine called *lora*, in the consumption of which they were unrestricted. Columella and Pliny give the particulars of its manufacture, and

Dickson supposes it to have been equal to small beer. For the rest of the year they had real wine, and, by a very elaborate calculation, Dickson makes out the daily ration to have amounted to rather more than a pint and a half English. We take all our quantities on trust from Dickson. Any person who is curious on the subject will find the data given at length in his work.

Cato, having fed his household, proceeds to clothe them. The passage is not very clear, but we take it to mean that each individual received a tunic (a jacket without sleeves) annually, and a saga, three and a half feet long (probably a smock frock) biennially; also a pair of good wooden clogs every second year. Cato prescribes, that before you serve out a new tunic or saga you should receive the old one, to be used in the manufacture of *centones*—that is, rough cloaks of patchwork, serviceable also as bed-quilts. Ausonius, in the preface to his *Cento* from Virgil, has many quaint allusions to the origin of the literary term.

We have said that the general tendency of these old writers is against *high farming*, by which we mean a large outlay with a view to increased produce. At the same time they are unanimous in their condemnation of slovenly and indolent farming. They prescribe a degree of accuracy and care which is certainly unknown in our general husbandry. This we shall see more fully when we come to speak of their course of culture. They insist on a most careful application of all the internal resources of the farm, and guard most anxiously against any neglect or waste of an article which may be used in reproduction; but there are very few indications of their having looked beyond the boundary fence for any means of augmenting the fertility of their lands. Cato's maxims all tend to repress outlay; and Pliny discusses the whole question in a passage which is too long to quote, but which is remarkable both for its sentiments and expressions. He brings forward, apparently with some hesitation, the unanimous opinion of the ancients, that (in plain English) nothing pays worse than high farming—"nihil minus expedire quam agrum optimè colere." He gives an instance of a very rich man who ruined himself by farming for ostentation. He says there is a mean course, and he appears to intimate (though the passage is obscure), that a tenant, working himself and having a family which must be maintained, may do some things with profit which would be ruinous to a proprietor who lived at a distance, and hired the labour which was employed in doing them. He defends the ancients against the charge of having recommended bad farming. He says that by their oracular expression, "bonis malis," they merely meant that you should do things well and cheap; a point at which we have been aiming all our lives, and have never hit it.

Having cleared away these preliminary matters, we will now accompany the Roman farmer into his arable lands, and into his meadows and pastures, and will describe the management which he applied to each. We will take the latter and shorter subject first. As to pasturing, the details are few; but it is a pursuit much commended by the writers, on the characteristic ground that it calls for little outlay. Columella reports Cato to have answered the inquiry, how a man could get rich quickest by farming? "By being a good grazier." How next? "By being a middling grazier." "I regret," says Columella, "to add, that to the inquiry, repeated a third time, so wise a man should have replied, 'By being a bad grazier;'" though, as to his second answer, there can be no doubt that middling grazing is more profitable than the best management in any other line of agriculture. Pliny admits the two first responses to be genuine, but snubs Columella by discrediting the third. He says that Cato's purpose was to inculcate that we should depend most on those returns which were got at the least expense.* Meadows are included in the same category of commendation. All the writers agree that they were called by the ancients, "prata quasi parata," as being always ready to produce without culture. If you have water, says Cato, make water-meadows rather than anything. If you have no water, make dry meadows to the utmost extent you can. Minute directions are given for passing the water slowly and evenly over the land, without allowing it to stagnate. Too much water is said to be as objectionable as too little. "No doubt," says Columella, "the natural grass which a rich upland produces will make finer hay than any which you get by watering; but from thin land, whether it is stiff or light, watering is the only way in which you can get a crop." Pliny particularly recommends to turn over your meadows any water which runs from a highway. Columella and Palladius give precise instructions for renewing hassocky and mossy meadows by the plough. You will get fine corn crops from them after their long rest—"post longam desidiam." They are to be ploughed and well summer-worked, and sown in autumn with turnips or beans, and the next year with corn. In the third year they are to be very carefully worked till every weed and root is extirpated, and then sown with vetches and hay-seeds (the hay-seeds, says Pliny, may be collected in the haylofts and mangers), and the vetches are not to be cut till they have shed a part of the seed. The land must be worked quite fine and even with hoes and clod-crushers, so as to break down everything which might be an impediment to the scythe. The water is then to be laid on, but very gently if the surface is loose, because a force of water would wash the soil from the roots of the grass, and hinder them from making a strong turf. For the same reason you must not permit the new-sown grass to be trod by cattle. In the second year, if the ground is dry enough, small cattle may be admitted after the hay is cut; and if it has become very firm, the larger cattle in the third. If you wish for a full crop of hay, you must clear your early and weak meadows of cattle in January. Lands less subject to burn may be pastured till February or March. The manure, which should be the greenest you have, "recentissimum," and which may with advantage have hay-seeds mixed with it, should be laid in February on such parts of the meadow as cannot be watered. It seems probable that the majority of Roman meadows were ill-drained, so much stress is laid on the evil of treading them with cattle. Pigs also were interdicted, on account of their rooting propensities. M. Porcius is brought forward to testify to the value of meadows. They are less subject to injury by storms than any other part of the farm; they require the least expenditure; they give a crop every year, and, indeed, more than one, for the pasturage of the aftermath is of as much value as the hay. The Campus Rosea is said to have been the most valuable plot of land in Italy. We had hoped, and indeed believed, that the story of the stick was genuine Leicestershire; but Cæsar Vopiscus, the ædile, is produced both by Varro and Pliny, to vouch that in that celebrated field he laid down his stick overnight, and could not find it in the morning, because it was smothered in grass. The time which we claim, however, on behalf of Cestus Over is not a whole night, but only while the farmer ate his dinner and smoked one pipe.

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* Mr. Hoskyns gives a different interpretation to the passage, but has evidently mistaken its meaning.

The Romans frequently mowed their meadows twice, first in May, and secondly in August or September, and watered them between the mowings. They mixed the second crop with oak and elm leaves, and used it as fodder for sheep. Dickson calculates, on somewhat uncertain grounds, that the first mowing of a Roman meadow produced more than two and a half tons of hay to the statute acre. That the crops were large appears probable. To mow a jugerum, three-fifths of a statute acre in a day, is said to require a good workman, whereas an ordinary English labourer reckons an acre to be a day's work. All the writers prescribe that the grass should be cut before the seed is ripe, and before the stalk has become dry. Pliny boasts of a discovery of whetstones, which would sharpen a scythe with water; whereas the Cretan whetstones, which alone were known to their ancestors, would only sharpen with oil, in consequence of which every mower had a horn of that liniment tied to his leg. The Italians used short, the Gauls long scythes. Every maxim of English, and even of Scotch haymaking is diligently set forth: precautions against rain, against undersweating, and overheating. Pliny supposes that when hay is got too green the sun sets the ricks on fire. We have by no means exhausted the subject; but

"Claudite jam rivos; forsan sat prata biberunt."

The Roman agricultural course, with the partial exceptions to which we shall have occasion to advert, was of the simplest possible description—a crop of grain and a fallow. Every year one half of the arable land was in grain, one-half in fallow. One-third of the fallow was sown with some sort of green crop to be mowed for the cattle, and this portion of the fallow, and this alone, was manured; the result being, that the arable land was manured once in six years, and in that period bore three grain crops and one green crop.* This we should bear in mind when we come to consider what effect a long perseverance in this course had on production. The naked fallow received three or four ploughings during the summer, besides the seed furrow. To sow the grain in autumn was considered to be far the best practice; but any portion of the land which, from bad weather or other impediments, could not be completed in autumn, was sown in spring. The grain was wheat or barley. The wheat was of many varieties: white, red, black, bearded, and smooth are expressly mentioned; and these do not exhaust the catalogue of names.

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* Dickson ascertains by an elaborate calculation that, on a well-managed farm, sufficient dung was made to manure three-tenths of the land annually. It appears, however, from Cato and other writers, that a large portion of the manure was devoted to grapes, olives, and other fruit. Cato assigns half to fruit and half to grain, which would make the portion of arable land manured annually even less than we have stated.

Some are said to be suited to free and dry, others to strong and moist land. Siligo, triticum, and far adoreum appear to have been the favourite sorts; and the two first varieties cannot have been very far removed, if Pliny's statement, that siligo sown on certain lands for three years turns into triticum, be correct. He, however, starting with the maxim, that no book is so bad that something may not be learned from it, picks up a good many loose stories, and he is, if we remember right, the author who vouches that if oats be sown on a certain day of the moon, they will come up barley. Of barley there were several varieties, both in colour and form of the grain—"longius leviusque, aut brevius, aut rotundius, candidius, nigrius, vel cui purpura est"—of which Pliny says that the white was least able to stand bad weather. All the authors agree that barley prospers only in a free and dry soil. It was sown in September and October, and again from January to March. Spring sowing appears to be less condemned in the case of barley than of wheat.

The mode of sowing grain affords, perhaps, the most marked distinction between Roman and modern practice. Their system was twofold. The land was well reduced by the *irpex*, which was our harrow, and was used both for pulverization and for drawing weeds to the surface, and by the *crates*, which was an implement for crushing clods. Both these were worked by oxen. If the land were naturally dry, it was next drawn into ridges (similar, probably, to our turnip ridges) by a double mould-board plough. The seed was then sown by hand broadcast on these ridges, and the major part, of course, settled into the furrows. It was then covered by hand with *rastra*—*i. e.* rakes,* and lightly, for the ridges certainly were not obliterated. They are always spoken of as a beneficial defence against drought to the corn growing on dry land. If the land to be sown were moist, so that injury to the crop from wet might be apprehended, the seed was scattered on the reduced and level surface, and, the double mould-board plough being introduced, by its operation most of the seed was covered up in the ridge. Several of the writers say that he was a clumsy ploughman who required an *occator* to follow him for the purpose of covering any portion of the seed. The result of both modes of sowing was, that the corn came up in rows, separated by a considerable interval; so considerable indeed, that it was not unusual to plough between them after the corn had grown to some height. Dickson and Tull differ as to the meaning of the word *occatio*, and as to the operation which it indicates, Probably they were acquainted with passages in which Varro and Verrius derive the word from *occædere*, but neither of them seems to have been aware that a passage in the "De Senectute" completely settles the point—"quæ (sc. terra) semen occœcatum" covered up—put out of sight "cohibet, ex quo occatio (quæ hoc efficit) nominata est." After this covering of the seed the land remained quiet till wheat had put out its fourth, and barley its fifth, blade. It then received its first hoeing (sarritio), which in dry land included what we should call earthing up: in moist land, where the corn was already on a ridge, the operation was simple hoeing. A second hoeing was given in the spring. These two hoeings were the universal practice, and a third and fourth are spoken of. Even the careful Cato is inclined to think that more than two hoings may be given with advantage. Then followed hand-weeding (runcatio), which in the case of prickly plants was performed with a glove—"velatâ manu debet runcari." Pliny tells a curious story about

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* There is little or no evidence that the *rastrum* was ever drawn by cattle, though, from the expression "gravibus rastris," used by Columella in his poetical book, and "iniquo pondere rastri," by Virgil, commentators have assimilated it to our harrow. As Columella was speaking of an implement to be used, not on the farm, but in a garden, the reasonable conclusion is that it was to be worked by hand. Probably a

heavier rake was used for levelling ridges and for breaking clods than for giving a light covering to seed. It is doubtful whether the Romans ever used the harrow to cover seed.

the origin of the still further operation of ploughing between the rows of corn. In the course of a razzia, which seems to have taken place in spring or early summer, the Salassi easily destroyed the winter-sown crops of their enemies. But the panic and millet, which were only just coming up, were not susceptible of the same sort of injury. They were therefore ploughed in. As however the crops recovered, and proved unusually abundant, husbandmen adopted the practice of ploughing among their corn, either when the spike was just showing itself, or when it had put forth two or three leaves; probably about the stage which we call spindling.

The whole operation of growing a crop of wheat or barley was, as respects two-thirds of the crop, as follows:—A bare fallow extending from June (the time of harvest) to the September in the following year: four or more ploughings, and efficient breaking down by harrows and other implements; two or more hoeings and a hand-weeding. This is represented to have been ordinary practice, and the maxims are in conformity. "He," says Columella, "appears to me to be the very worst of farmers who allows weeds to grow among his crops. The produce must be exceedingly diminished if weeding is neglected." On this point we must let Dickson speak for himself. "When we consider how frequently in the ancient husbandry the land was fallowed, how frequently and at what seasons the fallow was ploughed, we are apt to imagine that there would be very little necessity for weeding; and yet the care of the Roman farmers in this article seems to exceed their care in every other thing." Weeds, however, were not the only objects of the hoeings. The ancients considered that the growth of corn was much promoted by stirring the ground. One, or frequently two, of the four ploughings having been given to the bare portion of the fallow-break before winter, a larger proportion of the force of the farm could be devoted to the land which was sown with crops to be mown green for the cattle. Day by day it was ploughed down as mown, a point on which the writers insist very strongly, and it appears to have received the same culture which we have described above. The fallow-break was called *vervactum*. In addition to these ordinary corn lands they had a small proportion which they called *restibilis*, as being capable of great endurance; land which had qualities analogous to those possessed by a horse which can go at a great pace and stay at it; or by a vocalist who can hold a note for an indefinite period. This land bore a crop every year. Pliny speaks of land which was so kindly that the crop smothered everything and required no weeding;* and Cato says, that as soon as the corn was cleared off, this land might be sown with vetches on a single furrow without manure, that it might be pastured down in December, and would still yield an undiminished crop in spring. Lands which had rested long, or were fresh brought into cultivation, were called *novalia*, and were subjected to a severer course of cropping than the old tilled land. Barley was considered to be a severer crop than any other. This epitome of grain-growing as practised by the Romans was applicable not only to Italy, but certainly to Sicily, to Spain, to the province which they called Africa, and probably to other southern provinces. Particular notices occur of parts of Syria and of Egypt, and Mesopotamia, where inundations made all the land restibilis. Practices to which we shall briefly refer are spoken of by Pliny as prevalent in Gaul and Britain, which are represented to have been grain-exporting provinces.

We must lump together in one sentence the various herbs which were cultivated by the Romans as green food for cattle; and we regret that we can give so little information respecting them. Cicer—pulse of some kind—*unde*

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* Pliny's expression is "omnia hæc" (*i.e.* hoeing and weeding) "supervacua facit indulgentia cœli." Columella says, "cœli conditio et terræ bonitas ea est," &c. Columella says also, that on ordinary land lupines are the only crop which does not require weeding, because they smother all weeds.

Cicero—Ervum, often coupled with Cicer—Farrago, probably mixed corn to be mown green—Ocimum, of which all we know is, that Pliny says it was supposed to flourish most when sown with cursing and railing—Vicia, vetch—Cytisum—(remembering the word in Virgil's first Eclogue, we turned to the commentary and found this explanation): "Genus fruticis sive herbæ cujus species multiplex, et descriptio apud diversos diversissima:"—Lentils, lupines, fenu-greek, *pisum*, peas, *faba*. The Romans cultivated more than one sort of bean, and probably this *faba*, which was mown green for fodder, was the kidney bean. Cato leads the way with most minute directions for sowing these green meats, and is followed by the other authors. The first crop to be put in as soon as the corn is off the land: this will be ready for autumnal mowing; and two or three succession crops to last for the remainder of the year.

To the Medica—probably lucerne—Dickson devotes a chapter, and we must devote a sentence. Though Pliny says that it was brought into Greece "a Medis per bella Persarum, quæ Darius intulit," it appears to have been unknown to Cato and to Varro as an object of Roman culture. Virgil mentions it once as being sown at the vernal equinox, and as requiring very rich land. Columella, Pliny, and Palladius are full of its merits. The sum of their praises is—that one sowing lasts ten (Pliny says thirty) years; that it may be mown from four to six times annually; that it fattens lean, and cures sick cattle; that it enriches land; and that the produce of three-fifths of a statute acre will abundantly maintain three horses for a whole year. These statements appear to some modern agricultural writers marvellous or miraculous. We believe however that, bating the thirty years and the enriching land, they are constantly equalled now a-days in the fertile island of Jersey. Beans were considered a very valuable crop, and were subjected to very careful cultivation.

Hemp, flax, poppy, panic, and millet, were Roman crops; but we fancy only incidentally and in by-corners, and not in any regular course of culture.* *Legum* or *legumen* did not imply a class of plants; but all crops which were pulled up by the root† instead of being cut by sickle or scythe. Hence, beans, peas, flax, hemp, &c., are spoken of as *legum* as well as turnip, rape, and radish. On turnips the later authors are diffuse, but we must be concise. Pliny declares that no crop is so valuable except grapes and corn; that they are most wholesome food for man, and excellent, dressed in a variety of ways; that they keep through the year, either pitted, or when mixed with mustard; that they are most valuable in ornamental cookery, as capable of receiving six colours besides their own, one of the colours being purple—a quality possessed by no other kind of food; that when boiled they will feed fowls, and that the leaves are good for cattle; and finally, that he has seen one 40lb. weight. Columella says that in Gaul the bulbs are used as winter food for cattle and sheep. As to culture, the Romans sowed the best sort of turnip after five ploughings on dry and free land, in rows well manured; thinned then to eight inches asunder; and, like us, were very much plagued by the fly (culex), which they combated with soot, steeped seed, and other remedies similar to our own, and probably about as effectual.

Many passages occur in the writers, which, taken singly, appear to indicate a strong opinion on their part, that whereas some crops exhausted, others improved the land. Probably, however, the majority of these passages have reference to a practice which was very prevalent in their agriculture, namely, sowing vetches, beans, and more especially lupines, for the purpose of ploughing them in when they began to form seeds. By the writers generally more benefit is attributed to this practice than modern experience would appear to justify. It is true, that in the Roman course of a crop and a fallow no time was lost by it. The opinion also that some crops, even when gathered, improved the land, did prevail—for Columella, who strongly advocates the ploughing-in system, thinks it necessary to combat it:—

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* Flax is universally condemned by the writers as an exhausting crop. Pliny however enters largely not only into its cultivation, but into the mode of steeping and dressing it, and into its manufacture into fine linen, sail-cloth, candle-wicks, fish-nets, and snares for wild boars. He says that each thread in a then extant breast-plate of Amasis, king of Egypt, consisted of 365 ply.

† Dickson, not adverting to this meaning, is surprised that Columella should reckon turnips among the pulse—*legumina*.

"Some tell us that a crop of beans stand in the place of a manuring to the land—which opinion I would interpret thus: not that one can make the land richer by sowing them, but that this crop will exhaust it less than some others. For of this I am certain, that land which has had nothing on it will produce more corn than that which has borne these pulse in the preceding year."

An opinion in which we cordially coincide.

Roman harvesting presents several variations from British practices. In some cases the ears of the standing corn were gathered by a sort of comb, cut off, and carried to the thrashing floor—the straw being cut by a subsequent operation. The mode in which this was done is accurately described by the writers, and is vividly portrayed in the drawings from the Egyptian tombs. This plan is said to have answered well in thin crops, but to have been troublesome when they were heavy; it would no doubt be still more so when they were laid and twisted. In other cases the corn was cut low, and having been gathered together, was passed through combs or hackles, which detained the ears. These being cut off, were carried away separately in wicker-baskets. Pliny remarks, that both these modes are favourable to straw which is to be used for thatching. About Rome the corn was cut in the middle by a sickle. Varro is of opinion that from this cutting in the middle, the word *messis* was derived. The upper part of the straw was called *palea*, and was used for fodder; the butt ends, *stramentum*, were used as litter. In some countries they pulled up all their corn by the roots, and fancied, says Pliny, that the disturbing the surface thereby was beneficial to the land. The reaping on Achilles' shield is similar to ours, except that it implies a greater division of labour than we usually carry out. In a previous passage, Homer declares the practice of rich men to have been, to start a gang of reapers at each end of a field of corn, and to their approach he likens that of the Grecian and Trojan hosts. Pliny, in a very obscure passage, and Palladius, in one which is more minute, describe a reaping machine which was used in the large farms in Gaul. We do not think that Messrs. Ransome and Mr. Hornsby would take the words of either author, or both combined, as working directions for the construction of the implement. This much is evident, that the body of the machine was fixed on an axle which connected two wheels. To the axle were fixed a pair of shafts, into which a very steady working ox was harnessed, not in the usual manner, but, as a stable-boy would say, with his head where his tail should be. Consequently, when he walked on, instead of pulling by the shafts, he pushed by them, and drove the implement into the standing corn. By some machinery which we cannot undertake to describe, it collected ears of corn, cut them off, and dropped them into a receptacle—"in carpentum:" Pliny says "vallum." Palladius says that this implement answered well in open and even land, and that some farmers in Gaul cut their whole harvest with it without employing any reapers.

Threshing presents as many varieties as reaping, and most of them must have been very old. Almost every one can be identified with some expression in the 27th and following verses of the 28th chapter of Isaiah. Threshing was generally performed immediately after harvest, and frequently in the fields; but Columella says, that where the ears only were cut off, they could be carried into the granary and threshed during the winter. The threshing was by flail, by treading out (for which horses are said to have been better than oxen), and latterly by a machine drawn by cattle, described sometimes as having teeth, sometimes rollers, called *tribula*, *traha*, and *plostellum*, and which, whatever it might be, was adopted from Carthage. All the writers put forth their strength in describing the construction of the *area* or threshing-floor. Cato forms a concrete-like surface of heavily rolled and rammed earth (cylindro aut paviculâ coæquato), and saturated with the lees of oil (amurca). Varro follows his lead; Columella adds that the floor is improved if straw be introduced into the mixture. Pliny and Palladius macadamise flint, pound it, and roll it with the fragment of a column; but the latter mentions a floor "saxo montis excisa," we suppose flagged. Virgil, in a charming passage, which is as poetical as it is correct, constructs a threshing-floor. Two lines suffice to prescribe the handworking of the earth, the levelling it with a very heavy roll, "ingenti cylindro," and the covering with a solid surface of chalk: a third line points out that weeds and dust, which would spoil the grain, should be guarded against; while six more suffice to specify those peculiar habits of mice, moles, toads, weevils, and ants respectively, from which injury may be expected. Four words thrown in by way of &c. conjure up ideas of centipedes, earwigs, woodlice, and other disgusting inhabitants of cracks and chinks.

The Romans would not have incurred Mause Headrigg's reprobation by "impiously thwarting the will of Divine Providence, in raising wind for their ain particular use by human art." They were content for the most part to "dight the corn frae the chaff" by casting it with shovels in the teeth of a moderate wind. In cases, however, of protracted calm or other emergency, Columella recommends the use of a *vannus*. It is mentioned by Virgil among the "duris agrestibus arma," as "mystica vannus Iacchi;" and was no doubt a fan of some sort. The words are the same. They also used sieves to free the grain from dust. These are mentioned both in the Old and New Testament.

The modes of using straw were various, and the variations were local. Ordinarily the upper half was used as cattle food, the lower as litter; but when the former failed, the latter was bruised on stones—a rude anticipation of our chaff-cutting—and sprinkled with salt to induce the cattle to eat it. Columella sets very little value even on the *palea.* He says that in many places cattle are fed on it from necessity, but "minus commode." Varro directs that where the ears only of the corn have been reaped, the straw should be cut and gathered immediately after harvest; but that if the crop were thin and labour is scarce, it will not pay for this, and it should then be pastured with cattle as it stands. Thatching houses with straw is spoken of as a practice confined to particular localities. Cato is precise, that every spike of straw or stubble should be gathered for litter, and even that it should be eked out with leaves of ilex. Virgil says, that to burn the stubble on barren land is good practice. Pliny, noting that this is done "magno Virgilii præconio," adds, that the principal benefit arises from the destruction of the seed of weeds. Both Isaiah and Obadiah allude to the practice of burning stubble. In classing straw as fodder, the writers all agree in the order of merit—millet, barley, wheat. The straw of pulse only was given to sheep.

As to manure, the directions of the prose men are rather precise than cleanly, and we shall not enter into the subject very largely. It is only Virgil, as Dryden says, who can "toss his dung about him with the air of a gentleman." The value of every living creature on the farm as a manure-making machine is most minutely weighed up; and the separate sorts of manure are classed according to their respective values. The schedule presents some variations from modern opinion. The manure from water-fowl is said to be of no value, which contrasts strangely with our appreciation of guano. Columella puts manure from pigs at the bottom of the list, for which Pliny sneers at him. We stumbled somewhere on a passage interesting to modern farmers which we cannot now refer to. The purport was, that part of the value of corn given to cattle is replaced in the increased strength of the manure. A diligent collection of everything which can beneficially swell the bulk of the heap is prescribed—leaves, weeds, scrapings of highways, &c. He is a very idle farmer, says Columella, who does not get together some manure, even if he does not keep cattle. The only allusion to extraneous manure, purchased for the farm, is confined to that made in aviaries, which seems to have been sown by hand both on meadows and on corn. Cassius is quoted as a great authority on the respective values of manures. Cicero and Pliny enter into the early history of manuring. The former says that it is singular that the learned Hesiod, writing about agriculture, should not have said a single word about manuring, whereas Homer, who lived so many ages before him (*ut mihi videtur*), represents Laertes to have soothed the regret which he felt on account of his son, by cultivating and manuring his land. In the descriptions of Laertes's gardening, as it has come to us, there is not a syllable about manuring; whereas in the seventeenth book of the Odyssey there is a distinct notice of a manure heap, and of the agricultural purpose to which it was to be applied. Pliny asserts the antiquity of the practice, follows Cicero in the story about Laertes, and adds that King Augeas first discovered the advantage of manuring in Greece, and that Hercules published it in Italy: a statement which appears to negative the claim of King Stercutio to the invention for which he was immortalized and worshipped. Far be it from us "tantas componere lites." The marvel would appear to be, not that a cultivator should make the discovery, but that any one should miss it.

Close on the heels of the directions for collecting and multiplying manure, follow those for its manipulation and management. Dickson revels in the middens. Skilful husbandmen, say Columella and Pliny, cover up their heaps, and suffer them neither to dry by the wind, nor to be parched by the rays of the sun. Hollow water-tight receptacles which retain the moisture are recommended.

Either oak leaves should be intermixed, or an oaken stake driven into the heap to prevent serpents from breeding there. Columella delicately observes that the treasure should not be piled up in front of the parlour (prætorii) windows. Cato and Varro say that manure, heaped, turned, and rotted down, is stronger than when green. From this opinion Columella and Palladius dissent, holding that the benefit of the turning and fermentation consists in their destroying the seeds of weeds, but that they weaken the manure; and they therefore prescribe that it should be applied quite fresh to grass land, where the weeds cannot so easily get root. Palladius thinks it necessary to wash seaweed in fresh water before it is used as manure. Manure was principally applied in spring and autumn. A little and often was considered to be the best practice. Wet land required more than dry. Dickson ascertains that 800 Winchester bushels of well-prepared manure to a statute acre was an average Roman dose. Pliny says that some persons think that land is best manured (optime stercorari) by having sheep, perhaps cattle (pecora), folded on it.

Theophrastus says that mixing earths, "ponderoso leve, levi ponderosum, macro pingue et contra," will often stand in the place of manure. Columella also records that his uncle, who was a most scientific and industrious farmer, improved his land by applying chalk to his sandy, and sand to his chalky and clay soils. Pliny, giving vent to the contempt for Columella which he is so little careful to conceal, says, "that is the practice of a madman. What can a man hope for who cultivates in this manner?"

Though lime was used agriculturally by the Romans only in their vineyards and orchards, we cannot wholly pass by the curious information which Dickson's chapter on the subject contains. Cato recommends its application to olives, and Pliny to vines, but more particularly to cherries. He says that cherries were unknown in Italy till Lucullus introduced them after his victory over Mithridates, A.U.C. 680, and that, within 120 years of their introduction, they were dispersed by the Romans as far as Britain. We are very much inclined, however, to claim an indigenous origin for our bird-cherry, and for the Scotch gean. We learn from Palladius that builders and plasterers were as fastidious about lime in his day as in ours, each requiring the limestone and the sort and quantity of sand appropriate to their operations respectively. Cato describes most minutely the mode of building the kiln and of burning the lime. We may certainly consider it as a singular proof of his sagacity, that, for several years last past, the practice of lime-burning in England has tended to return to the principle which Cato prescribes, from one which had long been considered as a great improvement. Limeburners will understand us when we say, that Cato's principle was, close fires and a very obstructed supply of air, each kiln-full of lime being an independent burning. The modern practice among large limeburners has been, till recently, deep open-topped kilns, supplied with fuel and limestone on the surface, the fire being urged by a brisk draft of air from the bottom, which served also to cool the lime in its descent to the holes in the kiln-bottom, whence it was drawn in a continuous stream. We have some experience in the matter, and believe that, in point of economy, Cato is vindicated. He also describes a system of burning lime in partnership. The owner finds the stone, the kiln, and the fuel. The working partner quarries the stone, and finds all the remaining labour. They divide the spoil. The practice is not unknown now, nor do the proportions vary very materially; but our division is less favourable to the working partner, and ought to be, because our fuel is so much less cumbrous. Although Pliny limits the agricultural use of lime by the Romans to olives, vines, and cherries, he says that the Hedui and Pictones (the people of Autun and Poictiers) made their general land very productive by its application.

Varro reports, that when he led an army through Trans-alpine Gaul as far as the Rhine, he passed through a country having neither olives, vines, nor apples—where they manured the land "candidâ fossiciâ cretâ." Pliny says that on wet cold land in Megara the Greeks, who tried everything, applied "leucargillon." In Gaul and Britain, however, what we call marling appears to have been a staple practice in husbandry, and to it Pliny devotes several pages. He enumerates six different kinds of marl, called marga, terra fullonia, glischromargon, eglecopala, capnomargos, and other fine names. Some were clayey for light lands; some sandy for heavy lands; some rocky, and retaining that form, to the great hindrance of stubble-mowing, till several years of sun, rain, and frost reduced them. Some lasted 10 years, some 30, some 50. Some were got at the day; and one sort, which lasted 80 years, and which no man had ever been known to apply twice to the same land, was got in Britain by means of narrow pits 30 yards deep. The mode of working described by Pliny is similar to a sort of rude coal-getting, which is now sometimes practised, where the seam lies at no greater depth. We have seen superficial marl pits in the midland counties, in which grow the ruins of ancient oaks, acorns perhaps in the time of Pliny.

The general corn lands of the Romans were not enclosed or fenced, except occasionally against public highways. They were acquainted, however, with every species of fence which is now in use, and applied them to vineyards, gardens, orchards, cattle-folds, and parks in front of the villa in which wild animals were confined, "ut possidentis oblectarent oculos." Palladius, the last of the writers, recommends that meadows should be enclosed. Quick fences—"vivæ sepes"—says Columella, are preferable to dead, because a mischievous fellow going by with a torch cannot set fire to them. They were raised from seed, with much preparation and culture, in which pea-meal and old ship ropes bear a conspicuous part. Directions may be found in one or other of these authors for raising every sort of fence which now prevails in Great Britain or Ireland. Pliny particularly describes the frame by means of which such mud walls as are now seen in Buckinghamshire and adjoining counties were reared. He limits them to Africa and Spain.

Notwithstanding the ameliorations of climate which we are told to hope for from draining, we do not expect to see vines an object of the British farmer's culture, nor wine-making one of his household labours; we shall, therefore, merely intimate that any one, who is anxious to learn "the ancient" practice in these matters, will find ample information in the agricultural writers. Beer comes home to our sympathies. Pliny says bluntly enough—"The western nations have their own way of getting drunk, by steeping barley. In Gaul and Britain the ladies use the yeast (spumam) as a cosmetic." This art we fear is lost; but if the patriotic member for Derby will listen to the voice of antiquity, Bass's Kalydor may become as celebrated as his Pale Ale. The second use of yeast survives. These nations, says Pliny, used it for fermenting their bread: "Quâ de causâ levior illis quam cæteris panis est." But the use of beer was not confined to the western nations. The Egyptian *zythus* was beer—Suidas says ἀπὸ κριθῆς γινόμενος, made of barley—and Pelusium was the Burton-on-Trent of Egypt:—

"Ut Pelusiaci proritet pocula zythi."

Moreover, the Egyptians, being destitute of hops, flavoured their ale with the bitter lupine, and with an acrid wild carrot, of which Pliny says—"nemo tres siseres edendo continuaret." Wilkinson, most properly, devotes two or three pages to the Egyptian zythus. In Spain they made beer which would keep for several years. Tacitus speaks of German beer more scornfully than is consistent with its modern reputation. "Potui humor ex hordeo aut fermento in quandam similitudinem vini corruptus."

Beer runs through all the classics. Athenæus says that beery men dance, and sing, as merrily as those who are overtaken in more generous liquor. Aristotle states, with more discrimination, that the former, when helplessly overcome, lie on their backs, and the latter on their faces. Æschylus, Sophocles, Herodotus, Archilochus, Hecatæus, and Aretæus all mention beer. Xenophon, during the retreat of the Ten Thousand, passed a convivial night with an Armenian sheik near to the sources of the river Phasis. The sheik's daughter, who had been married nine days, graced the feast with her presence. Her husband was not of the party, being off in the mountains coursing. On the floor of the subterranean dwelling stood a vessel filled with barley-bree, and furnished with hollow reeds of various sizes. Want of a common language did not prevent the observance of customary convivial compliments. The host, as his benevolence prompted, led some favoured guest to the beer-barrel, where the politer sort sucked the liquor through the reeds; but others, who had not learned manners, thrust in their noses like oxen. Xenophon says it was strong drink, but very pleasant when you were used to it. When the sun had risen on their revels, Xenophon, who commanded the rear-guard, took the sheik with him to the van of the army. There they found that General Cheirisophus, and his officers, had also met with good quarters, and were still protracting their festivities. They were crowned with rushes, and Armenian boys were ministering to them. To these boys they indicated by signs the form in which their services were required. Seven days were spent in these pastimes. On the eighth they took the sheik for their guide, and his son as hostage for his fidelity. The sheik led the army three days' march into the snow. Cheirisophus suspected treachery and struck the sheik, but neglected to fetter him. The sheik, resenting the indignity, levanted in the course of the night, leaving his son behind him. Then arose the only serious difference of the whole retreat between Xenophon and Cheirisophus, probably as to the fate of the boy. That however, was settled by another general, Episthenes, who, having taken a fancy to the boy, carried him to Greece, and he proved, says Xenophon, very faithful.

In treating of fallows, we have spoken of the number of ploughings which the Romans gave to their land; but our description would be incomplete if we did not allude to the manner in which they were executed. On this point some passages are obscure, and Dickson is neither a very definite nor a very safe guide. He wishes to conclude from a single expression in Pliny, which appears as likely at least to refer to the width as to the depth of the furrow, that the ordinary Roman ploughings were nine inches deep. As we know that they were generally executed by two oxen, and that a jugerum, three-fifths of a statute acre, was a regular day's work, and was in free land considerably exceeded, a general depth of nine inches will not, to a practical farmer, appear very probable. They were not, however, very superficial, for Pliny will not allow a depth of four fingers—three inches—to be a ploughing; but calls it a scarification. As, moreover, one ploughing in the fallow course received a distinctive name, "proscindere," with respect to which Pliny says "vi omni arato," and as he states that it was not unusual to attach six or even eight oxen to one plough, it seems probable that once at least in the fallow course the land was stirred to a considerable depth. There are several maxims about going below the roots of all the weeds. We should bear in mind that the Roman plough was an implement which did not of necessity turn a furrow, though it was capable of doing so by a direction given to it by the man who presided at the stilts. Our word furrow implies a slice of land turned over, whereas their word "sulcus" implies only a certain breadth disturbed and lightened up. The object of their fallow ploughings, and indeed of all their ploughings, except breaking up turf and the ridging which we have already described, was to stir all the land to an even depth. To effect this, they prescribed very narrow and equal breadths and very straight lines. They had not the trouble which we experience, from the circumstance that the plough in going and returning turns the slice opposite ways. The Roman ploughman returned on his own traces, and one criterion of the perfection of his work was, that the surface should be left so even as to make it difficult to discern where the plough had gone. The overlooker is recommended to walk over the newly-ploughed field, and to thrust in repeatedly a pointed stick, by which he will discover whether any land has been left unmoved. In order to ensure perfect culture, their second ploughing was always across the first. And even when the declivity was so great that they could not in either case go directly up and down, they took two oblique directions across the hill which would intersect each other. The characteristic of Roman ploughing was precision. To move uneven breadths was called to plough "sulco vario," and was much condemned. Lumps of earth undisturbed were called "scamna," and were said to diminish the crop, and to bring a bad name on the land. He who ploughed crooked was said to prevaricate, "prævaricare;" whence, says Pliny, the phrase was imported into the law courts, and having been applied to those who went crooked in their ploughing, came to be applied to those who went crooked in their statements. The ridge on which corn was sown was called "lira" and "porca." "Liras rustici vocant porcas." With us Prince Albert and Mr. Pusey have superseded the ridge-backed sow. We were content to look no further than "lira" for the derivation of the word "delirare;" but Mr. Hoskyns insists that it should be "de lineâ arare," whence also delirious. We wish some skilful husbandman would import these Roman maxims into the midland counties, where nineteen ploughmen out of twenty either prevaricate or are delirious.

So great was the importance which the ancients attached to ploughing. "What," says Cato, "is the first point in good cultivation?" "Bene arare.—Quid secundum? Arare.

—Quid tertium? Stercorare." Pliny declares the passage to be oracular, but muddles it in quoting. Theophrastus, who long preceded them both, says that no crop ought to be grown on the fallow-break unless it can be cleared off so soon as not to prevent the land from receiving all its summer ploughings. Cato forbids his bailiff to plough when it is wet, or to cart over it, or even to allow cattle to go upon it. He says that it will not recover itself for three years. Columella, Pliny, and Palladius say that if you meddle with land while it is wet, you will lose the whole season. Dickson is very elaborate in investigating the construction of ancient ploughs, and appears to be borne out in the following conclusions:—

"The ancients had all the different kinds of ploughs that we have at present in Europe, though perhaps not so exactly constructed. They had ploughs without mould-boards, and ploughs with mould-boards; they had ploughs without coulters, and ploughs with coulters; they had ploughs without wheels, and ploughs with wheels; they had broad-pointed shares and narrow-pointed shares; they even had, what I have not as yet met with amongst the moderns, shares not only with sharp sides and points, but also with high-raised cutting-tops. Were we well acquainted with the construction of all these, perhaps it would be found that the improvements made by the moderns in this article are not so great as many persons are apt to imagine."

The Egyptian ploughs, as represented in the drawings, are mere mud-scratchers, drawn sometimes by oxen, sometimes by cows with their calves skipping by their sides; and Pliny says that, on flooded lands, he has seen a plough drawn by a donkey on one side, and an old woman on the other—"vili asello, et a parte alterâ jugi anu vomerem trahente." Among the drawings from the Egyptian tombs, engraved for Sir G. Wilkinson, are several which represent ploughing, sowing, and other operations, and in one of these a roller drawn by two horses driven with reins is introduced. The roller is hollow, supported by a framework inside, in diameter about two-thirds of the height of the horses, and the drawing would be no inaccurate representation of a modern agricultural iron roller. We are not aware that the use of such an implement in husbandry is mentioned by any of the ancient writers. If Columella had been acquainted with its use, he would not have recommended that land, laid down for meadow, should be smoothed by an instrument which, according to his own account, worked so clumsily as the *crates*. We have already seen, that in compressing a threshing-floor, a piece of a broken column was pressed into the service as a makeshift roller. The Romans might have valued this implement as a breaker of clods, and as an assistant to fine tilth; but not a single passage intimates that they sympathised with our idea of the advantage of a firm bed for the roots of corn. Quite the contrary. Perhaps, in the climate of Italy, their crops were not so liable to be top-heavy as ours are. Perhaps the young plant was not so liable to be thrown out by frost.

When we come to sowing, the remarkable unanimity which, on most points of practice, pervades the old authors, gives way to a diversity that sorely perplexes the minister of Whittingham. That candid judge expends much unsuccessful labour in attempts to reconcile their opinions; and, where this is hopeless, would fain make out that none of them can be convicted of heterodoxy. The directions given by them are very analogous to those which any gentleman would receive, if he were to enter an English county on one side, and ask the opinion of every farmer he met till he went out on the other. One would tell him to sow thin, because his land was poor, another because it was rich. A third would say, "Be liberal with your seed, because you are early in the season;" and a fourth would advise the same because you are late. A fifth and sixth would differ as to whether wet land, or dry, required the most seed.* This is the substance of what the ancients say in various passages—which we are not careful to harmonize, partly because their differences will dwindle when we mention the narrow limits between the thick and thin sowing. With few exceptions they recommend early sowing, and, as was their wont, enforce the practice by an epigrammatic maxim —"Early sowing sometimes deceives the husbandman; late sowing never—because the crop after it is always bad." Pliny will not have the joke, probably because he finds it in Columella, and gives the maxim—"Early sowing sometime disappoints the husbandman, late sowing always." Their mode of sowing was by hand, broadcast; or rather, according to the Egyptian drawings, overcast. A two-handed seedsman nowhere appears. We find in Theophrastus and Pliny an opinion which lingers still among seedsmen, where it has not been superseded by the drill. The same land was said to require varying quantities of seed in different years, and its taking much was "infausto augurio" for the crop. The land was supposed to be hungry, and to devour the seed. Theophrastus laughs at this as "fool's talk;" but Pliny says it is "religiosum augurium." Dickson explains the matter very naturally. In sowing, the step and hand go together. When the land is clammy the seedsman takes short steps, and gives the field more handfuls. A clammy seedness is generally followed by an unproductive harvest.

The next and last point of practice is the quantity of seed sown; and in our observations upon it we shall confine ourselves to wheat. We approach the matter with some anxiety, because on our accuracy respecting it hangs the only chance we have of ascertaining what was the productive return for all the laborious culture which we have described. We may state as a preliminary, that the

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* Probably he would not meet a farmer who would tell him, with Pliny, that if seed barley remains long in the ground without vegetating, it will come up oats.

Romans were extremely particular in the choice of seed. They insisted on its being sound, plump, and well formed. They selected by hand from the ripened crop the boldest ears, rejecting all those which had any deaf husks. They were aware of the advantage of introducing seed from land which varied in soil or climate, and they represent that the produce of seed, taken indiscriminately, always degenerated in a few years. On the subject of quantity the writers are nearly unanimous, and very precise. There is, perhaps, a slight tendency in those who wrote last to increase the quantity of seed. The smallest quantity of seed-wheat named is rather less than two bushels to the statute acre—the largest exceeds two and a half by a small fraction. Cato is silent on the subject of quantity; but all the other Roman authors are unanimous in fixing on five modii to the jugerum, or less than two bushels and a quarter to the statute acre, as the standard quantity of seed-wheat. Both in the Scriptures, and in the old heathen authors, statements occur of the returns of one hundred, and one hundred and fifty, to one. These are, undoubtedly, meant to express very large crops; but how large, while the seed is an unknown quantity, it is impossible to ascertain. If we take two bushels of wheat as the seed for an acre, no practical farmer will be very apt to believe that any one ever reaped 300 bushels, or 37½ quarters, of wheat from a single acre. By reducing seed, and by giving space and extra culture to each individual plant, an almost unlimited return, to one, may be obtained. That some such explanation must be given of these large statements is confirmed by the circumstance that, in the same passage in which Pliny makes them, he states also that an agent of Augustus sent him from Byzacium in Africa nearly 400 stalks (germina) from a single corn of wheat; and that Nero received from the same place 360 "stipulas ex uno grano." In our homely way, we saw last summer, a single bean producing 7 stems, 129 pods, and 519 beans, which any one so disposed might call a return of 519 for one. The return of the field from which this root was taken was 33 for one. When the Romans measure and state their seed, their pretensions are much more moderate. Varro, using a little above two bushels of seed to the statute acre, claims a general return of 10 for one; and of 15 in land of extraordinary fertility. That is, about 21 and 32 bushels per acre respectively. He speaks of this rate of produce as a great falling off from what had been obtained in the time of his ancestors. Half a century later, Cicero (*in Verrem*) gives an account of the produce in the rich lands of Sicily. He claims 2½ bushels of seed to the statute acre, and says, that well-cultivated land gives eight for one, or, "ut omnes Dii adjuvent . . . . quod perraro evenit," ten—equal to 20 and 25 bushels respectively. In another half century, Columella says that, over the larger part of Italy, the instances are few in which the return is more than four to one.* The increasing lamentations over diminished produce, as we descend in the series of authors, are quite consonant with these returns. They are confirmed also by unequivocal declarations in the later writers—that both the selling price and rent of land had declined, though the price of wheat had risen gradually from 3*s*. 6*d*. per quarter before, and 10*s*. in the time of Cato, to 60*s*. in the time of Pliny. The expense of agricultural labour had not, in the meantime, increased materially. Palladius, the latest author, states the price of an agricultural slave to be from 60*l*. to 66*l*. Cato is said to have paid for them 50*l*. each; but this is mentioned as being considerably below the market price, and is given as a specimen of his skill in purchasing.

We have thus brought to a close our long digest of ancient agricultural practice and produce. In renewing our acknowledgments to Dickson for the assistance which he has given us, we are bound to say that, for many of our statements, he is not answerable. Some things which he either missed, or purposely passed by, we have brought forward from the men of old; and in several cases in which he has appeared to us to misconceive their meaning, we have, after due consideration, followed our own opinion, without making the difference between us matter of controversy. His translations we have generally discarded. Several matters on which he dwells largely, but which did not seem to have much connection with British agriculture, we have omitted altogether. Equally, we have omitted the constantly-recurring directions of the ancients to govern ourselves, in sowing various seeds, or in eradicating particular weeds, by certain lunar and sidereal influences; and another class of directions, as a sample of which we may give, that a seed hopper ought to be lined with the skin of an hyena. Our reverend author is scandalised that some modern sceptics should have treated these maxims as superstitious, and is at much pains to prove that they are, or may be, consistent with sound reason. We by no means sneer at them, calling to mind that the best housekeeper we ever knew would never allow a pig to be killed when the moon was waning, because bacon cured under those influences would not, to use her own phrase, "swell in the pot."

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* Some attempts have been made to explain away or to discredit this passage in Columella, but apparently without any reason. His "cum quarto responderint" is exactly analogous to Cicero's "efficit cum octavo"—"cum decumo extulisset," and to the "cum decimo redeat" of Varro. In short this is the only way in which the ancients express the amount of produce.

We are quite aware how many unexpected matters may turn up when we come to reduce a system of agriculture, which is depicted on paper, to the rough realities of practice. But the Roman authors appear to us to have this peculiarity, that they never look forward, but always backward. Their anxiety is not to promote progress, but to guard against declension. It is enough for Columella and Palladius to cultivate as Cato and Varro directed, and Cato and Varro are satisfied to appeal to the Greek writers and Mago. No one of them, as far as we recollect, claims any improvement as of recent discovery. We have eras in our agriculture, but they appear to have had none. We can point to the period when the value of our sands was doubled or trebled by the introduction of turnip husbandry, and the consequent intimate union of the fleece and the plough. We can tell that, through general enclosures, the exhausted clays of our open fields were allowed to recover their fertility by long rests in grass. Sowing corn by the drill, threshing by horse power and by steam, permanent under-drainage, the new Leicester sheep and the improved short-horn, all attest our progress. They had nothing of the sort. They describe a very advanced and refined system of tillage, but they treat agriculture as an art whereof the origin is veiled in the mists of antiquity, which they do not seek to penetrate; which had descended to them in a state of perfection, beyond which they scarcely ventured to look; and which they must be careful not to deteriorate. Dickson's abiding faith is, that they were better farmers than the moderns, and, on almost every point where ancient and modern practice differ, he gives the preference to the former. Nor is he alone in these opinions. The very latest historian of the Papal States says, "Agricultural science has not been carried as high in Scotland as it was carried more than two thousand years ago by the Romans, as any one who has ever *studied* the *Scriptores Rei Rusticæ* will readily admit" (vol. iii. p. 637). Whether the Rev. John Miley, D.D., himself has ever *studied* them, though he puts the word in *italics*, we are somewhat doubtful; but, at any rate, from these judgments we appeal to the results. No one, we believe, doubts or denies, that the agriculture of Scotland, if imperfect, and the still less perfect agriculture of England, have resulted in constantly-increasing produce, and enabling those countries to supply not only an increasing population, but a population whose scale of maintenance—with the exception, alas! of the class of mere agricultural labourers—has been constantly improving. Confessedly the reverse was the case in Roman agriculture. The successive writers speak of the same districts, the same soils, and constantly deplore diminished produce. And yet they do not say that the land received fewer ploughings, or hoeings, or weedings; that manure was less carefully husbanded; or that a less scientific course of cropping was adopted.

This falling off, having reached its crisis in the time of the later writers, evidently puzzled them sorely. Columella commences his treatise with it, and says that the fault cannot be in the earth. She must have the same principles of fertility as heretofore—so he has recourse to absenteeism and luxury, and such other explanations as pass muster with us in settling an Irish or West Indian difficulty now-a-days. Pliny only discusses the mystery—"Quænam ergo tantæ ubertatis causa erat?" It was either, he says, that the earth was then cultivated by the hands of great generals, and rejoiced—"ut fas est credere"—in a plough crowned with laurel, guided by a ploughman who had received a triumph; or that these men planned their course of crops with as much judgment as their campaigns, and laid out their fields with the same diligence as their camps. One reason is about as good as the other. The latter might be applicable to the four acres of Cincinnatus or Attilius Regulus, but we are slow to believe that nature produces a generation of men who are all giants in mind, body, or spirit; and we have no doubt that the age of Cincinnatus produced the usual proportion of husbandmen of only ordinary intelligence and energy. We believe that failure was inherent in the system. Roman agriculture was founded on the assumption that culture alone would enable land to export corn continually for an indefinite period. They acted tenderly on the assumption, and said, *every other year*, "alternis annis." A constantly-diminishing produce—diminishing probably in proportion to the length of time during which the assumption had been put to the test—proclaimed its failure. On this assumption, Tull attempted to base a system; but it did not survive him. Mr. Huxtable enunciates it as a principle, and founds calculations upon it; but no farmer who ever lived, ancient or modern, has relied on it so little in practice. His boxed bullocks, shedded sheep, and pampered pigs, are a standing contradiction to his claim of a continuous yield of 16 bushels per acre. This, according to Roman husbandry, would be 32 bushels per acre in alternate years; with the addition (which we cannot stop to calculate, but the data for the calculation are given in Mr. Huxtable's pamphlet) due to a manuring once in six years. To Mr. Huxtable's assumption we oppose Roman results. He cannot cultivate better than they did; and between the time of Varro, and that of Columella, they reduced the yield from 23 bushels per acre to about 12! What shall we say to Mr. Mechi? Nine hundred to a thousand quarters of corn *bought* annually for consumption on a farm of 170 acres.* Does not the shade of old Cato haunt his dreams? "Patrem familias vendacem non emacem esse oportet." When we descend to instances which are less controverted, we find that the practice of Mr. Hutley in Essex, Mr. Hudson of Castleacre, and, in short, of every successful arable farmer in Norfolk, Lincolnshire, or the Lothians, is founded on conviction that land which exports corn continuously is not self-sustaining. Such of our agricultural readers as have the misfortune or the advantage of forty years' recollection, will confirm our statement that the great bulk of the English common fields—more particularly those which ran the rain off their surface—were, on the eve of enclosure, reduced to the state, described by Columella, of a return of about four for one. In fact, the common-field system, which was one of a continuous carrying off of corn with no other aid but fallowing, and a little light adventitious manure, soot, and so forth, had worn itself out.

And here we remark the great distinction between Roman agriculture and ours. Theirs was correct, precise, regular, persevering, careful, but altogether unelastic. Ours, coarse, without system, inaccurate, often wasteful, but full of resource. They saw their produce dwindle, and their country become more and more dependent on importation for daily bread; and, with every temptation in price, found no remedy. When our clays struck work, we resorted to a general system of enclosures, which enabled us to give them rest without entire abandonment; and we applied all our energy to obtain the wheat and beans, which they had furnished to us, from a description of land which every previous generation had considered to be wholly unsuited to such produce. We ransacked earth and sea, home and abroad, for adventitious manures. No doubt we have had great advantages. Any one who casts his eye over the list of British imports and exports, will recognise at once an enormous balance remaining with us of matters resoluble ultimately into manure. Indeed the account is almost all one way. In our hardwares and crockery we export no elements of fertility, and our exports of textile fabrics are but a small fraction in weight of the raw material which we had previously imported. We have to look far back for the period when we regularly exported grain, and when our imports of wool failed to balance, or nearly so, our exports of manufactured woollens. To set against all this there is great waste; but even the sea makes us some compensation, in the shape of fish and wrack, for the filthy contributions which our rivers pour continually into its bosom. The emerald fringe, which surrounds all our towns and most of our villages, attests the general balance and its application. The suburban lands, which are brought to the acme of fertility, as far as that can be attained by extra-manuring, form a very appreciable portion of the surface of England; besides which, lands lying at distances, varying with the facilities of carriage or back-carriage, assist in sweeping off the fertilizing matters which accumulate in our great towns. There is no evidence in the ancient writers of any such process. There can be no doubt that, after the conquest of Carthage, Italy imported largely, and that a large portion of her imports came as tribute, without much return. Probably the want of easy means of transport prevented the agricultural use of the manures which might have been economised in the towns. In the absence of such aid the constant repetition of corn crops, aggravated, in many cases, by a systematic robbery of the arable field for the sake of the more profitable vineyard, produced the state of exhaustion to which the progressive diminution of return so fully testifies.

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* We speak on the authority of the "Times" Agricultural Commissioner.

No point in agriculture is better established than that long rest (what the Romans called "longa desidia") in grass gives to land renewed, or increased, powers of producing crops when it is again restored to culture. No fact is so entirely unexplained. None so palpably contradicts all our maxims. Here is no tillage, no stirring up, no exposure to light or air, no succession of crops. What becomes of the doctrine that the roots of plants exude something which is noxious to their own species? A field is laid down in grass, and every year it exports something; beef, mutton, wool, milk—or bone, sinew, and muscle, in the shape of store cattle.* Coexistent with a continuous export is the anomalous fact of increased productive power. Of this remedy for exhaustion we have availed ourselves largely. Our extensive pastures are our storehouses of grain—our safeguard against protracted dearth. Serious alarm would soon cover them with grain again. Our history teems with protests and futile laws against the increase of pasture. The process was inevitable: agriculture was rebelling against exhaustion, and was adopting the only remedy which difficulties of transport then permitted; a remedy of which the moistness of our climate diminished the sacrifice, and perhaps also increased the efficacy. In addition to this *remedy*, we now possess a *preventive*. We prevent the exhaustion of our lands by the application of adventitious manures. But the remedy, whatever its deficiencies, is not attended by outlay. It is simply a pro tempore abandonment of cultivation. On the other hand, the preventive, to which we have given the fanciful name of *high farming*, is altogether dependent upon outlay. An outcry for the application of increased capital to farming is evidence that a state of exhaustion has been reached, or is in immediate prospect. When Sir R. Peel tells his tenants that an average produce of about 2 to 2½ quarters of wheat per acre cannot pay, he indicates that their lands have approached the state which Columella describes to have been reached in Italy.* To this result of their agriculture the Romans never systematically adopted a preventive, nor did they contrive any specific remedy. Their business was to conquer and rob the world: their provinces bore an overwhelming proportion to their domestic limits. So it is in our case: but our connection with our outlying dependencies was never framed on Roman principles, and their wide compass will not absolve us from the necessity of turning our attention, with painful intensity, on our internal resources.

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* We have no inclination to discredit the statement that a marked declension of cheese produce occurred in the old dairy lands of Cheshire, and was arrested by the application of bone manure, nor to throw any doubt on the chemical explanations which have been given of those circumstances. We may mention, however, that in the great midland cheese-making district, to which parts of five counties contribute, and in which the generality of the cow pastures have been from time immemorial unviolated by the plough, we never heard of any such declension or remedy.

Though the Romans never practised the resting system, any description of modern agriculture which should pass it by would be incomplete. In a new country a settler subdues a piece of land, flogs it to death and abandons the carcase, and then repeats the operation on a new subject. That is the agricultural system in large portions of the United States. A great part of Russian Finland consists of low irregular hills, which yield a spontaneous growth of fir-wood. When the trees in this puny forest have attained the size of a fence-rail, the cultivator sets it on fire, and following the burning with one or more ponies harnessed to a tool which cannot accurately be called either plough, hoe, or spud, but which in his hand jumps about with the agility of an opera-dancer, he scratches the wood-ashes into the little deposits of soil which exist between the protruding rocks and stumps, and with them some seed-rye; repeating this crop for two or three years, according to the staple of his soil; and then resigning his exhausted victim in order to renew the operation on the piece of forest which is next in succession. It would be difficult to improve his agriculture. A somewhat analogous occupation of various poor wastes was, within a century, known in England. In many of the enclosed counties, particularly in the Midland, Northern, and Western, whole districts are described by the appellation of up and down land. The agricultural principle was, to call on mysterious nature to renew the exhausted soil. The system was frugal, but slow. It might consist with pack-horses, perhaps with stage-waggons, but it was scouted by post-coaches, and exploded by railroads. It was not suited to a country fully occupied, and which had an increasing population. The gross produce was necessarily small, and could support neither high rents nor heavy payments. Every new agricultural device proposed to get rid of it.

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* From a printed circular letter of Sir Robert Peel's to his tenants, Drayton Manor, Dec. 24, 1849.

We can remember when it was treason to agricultural science to doubt that the four-course shift, with turnips consumed by sheep where they grew, was self-sustaining. Sufficient virtue was supposed to exist in the feet of the sheep to set at nought a principle which had been sanctioned by experience in every age and every clime. The answer to the statement that land stimulated by culture could not, permanently, export its produce without exhaustion was—rotation of crops and the four-course shift. Sane men assured the agricultural world, that a farm divided into four equal parallelograms, to be occupied successively by turnips, barley, clover, and wheat, would go on for ever on its own resources with increasing fertility.

But these flattering prospects were destined to be materially abated. Turnips missed, land was clover-sick: in short, Nature had not changed, and land, severely cropped, was exhausted. Now, rotations are at a discount, and the jargon about improving crops—which Columella despised eighteen hundred years ago—has ceased; and high manuring, in one form or other, possesses the agricultural mind. No instructor has a chance of a hearing unless he professes to teach the farmer how he can restore to the earth the nitrogen, or ammonia, or some mysterious element which every one admits to have been carried off to the mill, the malt-house, and the shambles. Why all this outcry about draining? Mainly because draining is a necessary preliminary to successful manuring. When land is surcharged with water, and runs the rain off its surface, one portion of the manure which is applied to it is rendered effete by wet and cold, and another portion is swum away; but if land be porous by nature, or is rendered porous by art, every particle and every element of the manure is available for reproduction. The counties of Norfolk and Lincoln produce tenant farmers who manure, not like the Romans, once in six years, but for every crop. Every schemer in agriculture professes to have a plan by which we shall drive foreigners from our markets by the mere exuberance of our domestic production. Some of all this may be absurd, some exaggerated, but it shows the bent of the national mind. Whenever the history of British agriculture is faithfully written, it will tell, not of a tame acquiescence in diminishing produce, not of the helpless iteration of a worn-out course, but of constant improvement. It may be truly said of the Roman agriculturist, that he farmed as his fathers did before him; but of no class of men could it be said less truly than of the British. Who among us would found his practice on an authority fifty years old?

It would be very easy—nay, it is daily practice—to write a description of British agriculture founded on undoubted facts, but which shall be a caricature. From the backward arable practice of grazing and dairying districts—from the wayside cows of arable districts—from wheat-fields sacrificed to hop-gardens—from desolate lands, the improvement of which has been impeded by difficulties of tenure and mixed and imperfect ownership—from some sacrifices to the picturesque—and from more to the cherished feelings, prejudices if you will, of resident proprietors, which forbid the absolute introduction of the rectangular system which scientific precision would dictate—any critic, viewing the country from the window of a railway carriage, might select a group of agricultural deformities. They would bear the same relation to our general husbandry which reports from the felon's dock and the police office would bear to our general morality. A discerning "commissioner" finds, in every district of Britain, some farming practice carried to considerable perfection, or some agricultural improvement urged to a considerable extent. The British farmer has acquired a sort of prescriptive right to be called pudding-headed, and beef-witted, and would hardly know himself by any other description. He adopts it with perfect good-humour; and yet, when he comes to be looked into, he stands out as the man who, under some disadvantages of climate and some of tenure, has urged a limited area, of no exuberant natural fertility, to an amount of produce hitherto unparalleled in the world's history—and is urging it onward still. There is talk, indeed, of throwing land out of cultivation, but action is all the other way. Never was the indomitable energy of the British agriculturist more conspicuous than at this moment. A fall in the value of every article of farming produce—which his experience gave him no reason to anticipate—has dealt him a blow under which he staggers. When abundantly-stocked markets have reduced the price of goods below the cost of production, the cotton-spinner takes to short time, the iron-master blows out furnaces, and the collier shuts up his pits for three days in the week. Under similar circumstances—guided, we hope, by a sure instinct, which we blindly follow without comprehending it—the agriculturists make an universal rush to produce more. Everybody is determined to confute Malthus, and to prove to him that he misplaced the ratios—that the agricultural ratio of increase will double the produce of a rural district much sooner than the procreative ratio will double the population. Sir Robert Peel tells his tenants that 2 or 2½ quarters per acre cannot pay. No doubt that is so. A gross produce of *4l.* or *5l.* per acre from the golden crop of the series cannot sustain a landlord, a tenant, a rector, police, bridges, gaols, churches, lunatic asylums, union workhouses, labourers, and a chancellor of the exchequer. We must have 2 or 3 quarters per acre more. Mr. Huxtable, Mr. Hudson, and all of us, are solving, or endeavouring to solve, the problem how to buy them (for buy them we must) for less than they will fetch in the market. We are trying to confute the Roman maxim—"bene colere necessarium est, optime damnosum." Our faith, if we have any, is in the power of consumption. We trust that the stomachs of all Her Majesty's subjects are in a course of progressive dilation. "Produce more," say statesmen authoritatively, philosophers dogmatically, protectionists dolefully, free-traders fiercely. If we were to suggest "produce cheaper," we hardly know whether we should meet with a seconder. This indeed would involve many severe struggles which we would fain be spared. Visions of the disruption of ancient connections—of the extinction of some deserving classes—of the application of the rule and square to the face of the country—flit painfully before our eyes. Having seen the domestic spindle and loom swept into the unsightly factory —almost every independent brook-side producer, in every class, absorbed into some leviathan steam-driven establishment—Her Majesty's mail-coach, and Mr. Newman's neat post-chaise attached to The Rail—we can hardly hope that agriculture alone will be able to maintain its old relations, and to resist the economical pressure.

We are unwilling to close this long article without a word or two more on some conclusions respecting our Gallic and British ancestors, at which we have arrived from a perusal of the agricultural writers of Rome. When her professed historians passed the boundaries of Italy, they occupied themselves little with any matters which had not immediate bearing on the career of Roman conquest. The nations to their north and west were unknown to history, were classed under the general appellation of barbarians, and nothing respecting them appeared worthy to be recorded except the degree of resistance which they were able to offer to the Roman arms. Of what Mr. Hoskyns appropriately calls their "inner life" we learn nothing. Even when Tacitus writes a treatise "On the Manners of the Germans," he gives an account of them which nothing but our respect for a great name prevents our calling childish and absurd. The people he professed to describe were a great nation, who repeatedly foiled the Roman generals, and destroyed their armies, and who, though harassed on their frontiers, were in fact never conquered. In epigrammatic and antithetical sentences he sets before us a state of orderly but very democratic freedom. Men inspired by romantic virtue, and restrained by puritanical morality; women chaste, constant, and devoted, as became the wives and daughters of such heroes. If the nation had a fault, it was a somewhat too great proneness to convivial hospitality. That their dwellings were covered neither with tile nor thatch, that the men wore a robe pinned on with a thorn, and that the semi-nudity of the females was only redeemed from indecency by their perfect innocence, is all that we learn about their lodging and clothing. A statement that they made an intoxicating liquor from grain; and three sentences, which are rather negative than descriptive, dispatch the whole subject of their agriculture. The conclusion of the treatise declines, with a prudent reserve, to pass any opinion on the apparently prevalent report that the remoter tribes combined the visages of men with the bodies of beasts. From such history, and from the statements and silence of Cæsar and Livy, we appeal to numerous, but incidental and entirely unsuspicious circumstances, which meet us in the agricultural writers. They appear to us to warrant the inference, that a settled condition of society, and considerable progress in the useful arts, existed in Gaul and Britain before those countries were known to the Romans. Indeed, we doubt whether civilization was not rather repressed than advanced by their classic invaders. Nor is this opinion inconsistent with the fact that they were conquered. That they fell before armies to whose equipment and training the accumulated science of centuries had been applied, is analogous to the case of the village hero, who, though he has by activity and pluck thrashed all his rural competitors, finds himself powerless in the hands of a professional prize-fighter.

The Romans found Gaul a country of large farms (latifundia), in which various agricultural appliances quite unknown to themselves were habitually practised. The Romans were ignorant of the general use of lime in agriculture—they learned it in Gaul. They found chalk beneficially applied to corn-growing, both in Gaul and in Britain. In both countries various marls were applied to various descriptions of soil with scientific discrimination. In Britain, a particular description of marl, which was used as a top-dressing to land, was got by pits 10 yards deep. This circumstance is very significant. Every one conversant with underground work will be aware that it implies some power of freeing the works from water, and some scientific mode of ventilating them. The heavy expense of such an improvement is justified by the statement that the benefit endured for eighty years, and was only repeated after the expiration of that period. That circumstance, again, implies a settled state of society and great security of property. A Roman writer is not likely to have invented these matters, and we attach much more weight to inferences justly deducible from them, than we do to Cæsar's vague statement, that no family ties existed in Britain, and that the connubial arrangements were analogous to those of the poultry-yard and sheep-fold. The case of agricultural implements is still stronger. Pliny states that the Romans, ignorant themselves of any other mode of separating flour from bran than a common sieve, found in Gaul a dressing-machine on the modern principle of a brush working in the inside of a porous bag, and brought it into use in Italy. We have already named the machine for reaping corn, which was so effective that, on many farms in Gaul, it superseded every other mode of reaping. We must recall to our readers what this machine performed. With no other aid than that of being kept in motion by a bullock, it collected the ears of the standing corn, cut them off, and dropped them into a chest which was part of the machine. Nothing of the sort is shown to have existed in civilized Egypt. In that country, as well as in Italy, the system of reaping the ears only, leaving the straw to be mowed by a subsequent operation, was in great favour; but the work was performed by hand. We believe that modern machinists have failed in every attempt to make a satisfactory reaping-machine; and among the vast and almost speculative variety of implements which grace our agricultural shows, we are not aware that one which has professed to accomplish this operation has of late found a place.* The single fact, that the north-western nations made fermented liquor from grain, may not indicate any high degree of civilization; but the statement, that, by the skilful application of one product of their brewing in the kindred art of baking, they enjoyed lighter bread than was known to the luxurious Romans, is not without significance.

In these cursory remarks we have confined ourselves strictly to deductions from the incidental statements of the agricultural writers. We are quite aware that this is a very narrow corner of a great field, which abler husbandmen than ourselves are occupying with resources which we do not pretend to command. We have the satisfaction, however, of knowing that our partial conclusions point in the same direction as their more extensive and elaborate researches.

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* This was practically true in 1850, the date of the author's statement; but in 1852 reaping-machines of good promise, though still imperfect, were introduced from America, and some English ones were revived which bid fair to become permanent implements.—EDITOR.

HIGH FARMING.

AN UNPUBLISHED FRAGMENT.

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HIGH FARMING.*

"If good farming will not pay, certainly bad will not," said Lord Stanley (Derby), or at least so his Lordship is reported to have said, at an agricultural meeting at Bury. The phrase was sufficiently expressive, but appears to us not to have been logically accurate; because, in our estimation, paying is the criterion of goodness in farming. If no sort of farming will pay, there is no good farming. "*Cadit questio.*" Then hurrah! for the wilderness. Let us withdraw from the gentle slopes and softened vales which we occupy so unprofitably, and restoré them to our predecessors, the elk and buffalo, the wild boar and stately stag, who at least did not weary heaven and earth with their complaints. We are not unreasonable. We admit any farming, which pays the rate of profit due, on a comparison with other trades, to its pleasantness, to its salubrity, and to the even tenor of its way, without deteriorating the freehold, to be positively good. If it pays a higher rate, or if it improves the freehold, it is comparatively better. If it does both, it is good in the superlative degree. When we speak on behalf of the agricultural interest we can enter into no compromise with farming which does not pay. Without claiming to be eloquent, we think that we could get up a fine sentence, and assure the farmer that it is his high destiny to provide sustenance for the race whose ancestor God formed in his own image; and that when he makes two ears of wheat grow where one grew before, he may glory in being the benefactor of mankind. But we are afraid that the self-importance which we might conjure up would fade away before a distress for rent and taxes, and that the sight of two stacks of wheat where only one stood before would fail to cheer the heart of the bold peasant—" his country's pride," or to dry the eyes of the mother of his children, when they had once been placed in the schedule of the bailiff. No! The object of farming is gain. Whether an agriculturist grows bread to strengthen man, wine to gladden his heart, oil to make him of a cheerful countenance, or opium to poison him; whether his barley be made into wholesome ale or deleterious gin, he has but one concern—does the cultivation pay? The landlord manufactures and brings to market corn and beef; the cotton-lord muslin and calico. Incidentally, the one class of products feeds mankind, and the other clothes them. But the price, not the application, concerns the producer. That is the commercial principle; and the closer either party sticks to it the more probable will be his success. We therefore, with some reluctance, but on conviction, lay aside all sentiment, and approach the subject of agriculture in the driest economical spirit.

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* 1. "The Improvement of Farming. What ought Landlords and Farmers to do?" By Ph. Pusey, M.P. for Berkshire. London, 1851.

2. "The Present Prices." By Rev. H. Huxtable, A.M., Rector of Sutton Waldron, Dorset. Seventh Edition. Blandford and London, 1850.

3. "High Farming, under liberal Covenants, the best Substitute for Protection." By James Caird, Farmer, Baldoon. Seventh Edition. Edinburgh and London, 1850.

4. "Report of a Visit to the Farms of Mr. Rigden, Sussex, Rev. Mr. Huxtable, Dorset, and Mr. Morton, Gloucestershire." By David Milne, Esq., of Milnegraden. Berwick-on-Tweed, Edinburgh, and London, 1850.

5. "Copy of a Paper on the Subject of British Agriculture read before the Society of Arts, November 27th, 1850." By Mr. J. J. Mechi. London, 1850.

6. "Free Farming to meet Free Trade." By Hugh Smith, Surveyor. London, 1850.

7. "Mr. Huxtable and his Pigs." By Porcius. Edinburgh and London, 1850.

8. "A Letter on Agricultural Education." By Charles Lawrence, Esq. London, 1850.

9. "On the Construction of Farm Buildings in Ireland." Dublin, Liverpool, and London 1850.

Having thus strictly limited the sense in which only we can consent to use the phrase good farming, we come next to another phrase of modern origin, but which now constantly occupies the mouths or pens of all agricultural disputants. We like the phrase because it is so very definite and so very unassuming. "High farming" is simply a higher, or more than average, expenditure of money on land, in order to make its agricultural produce greater. Extra expenditure in labour, in manure, or in machinery, is its essence. It passes by the subject of profit and loss. Agricultural journals have been content to record that Lord A., Sir J. B., or Squire C., have, by high farming, extracted thirty tons of swedes per acre from land whose previous produce was only fifteen. The record of the fact has not been accompanied by a balance-sheet. These individuals were spirited agriculturists—an epithet which may have been correct, but which sounds rather queer in connection with the most plodding occupation under the sun. When the grumblings of the agricultural classes rose higher than the recognised standard, and began to be somewhat of a nuisance to their non-agricultural fellow-citizens, the thirty tons of these spirited individuals were cast in the teeth of their more cowardly brethren, and they were bid to go and do likewise. They demurred to the mandate. The demurrer was, in substance, that high farming is not good farming, in the sense to which we have limited the latter phrase. The case is now on for argument at the tribunal of agricultural opinion; and at the head of this article we have placed before our readers a list of the arguments hitherto brought forward by the most eminent counsel in the cause.

We must assume two data, in both of which we believe that the conviction of our experienced readers will go along with us. 1st. That the natural produce of average land may be increased by manuring. 2nd. That with respect to all land which is not pestered with furrows, water-grips, ditches, and such abominations, and which consequently, either by nature or by artificial aid, absorbs all the rain which falls upon it, something approaching to a definite ratio has been established by experience between ingesta and egesta—between the quantity of manure applied and the increase of produce. If water runs off the surface of land, it is impossible to say how much this ratio may be disturbed. The manure applied may go to fertilize an alluvial meadow indefinitely distant, or to assist in forming a rich mudbank in the ocean.*

We will illustrate these data by the simplest case which is within our own experience, and will state the results. When on a portion of a field of meadow-land, which, in its natural state, would yield one ton and a half of hay per acre, we sow four cwt. of Peruvian guano, we find that the produce is in the first year increased to two tons per acre, and that in the second year an effect of a few cwt. per acre, certainly under five, remains. The outlay in guano, including cost, carriage, pounding, sifting, and sowing, is quite 45*s.* per acre. The result is, that we have bought hay at 3*l.* per ton, having some increase of aftermath to set against the harvesting of fifteen cwt. of hay. This suits us, because we are habitual buyers of hay; and this mode of purchase is ready, saves marketing and other interruptions. But were we haysellers, we are convinced that we should be losers, because in ordinary seasons the transaction would be about evenhanded, and once and again in a series of years comes a dry May and June, in which guano has little or no effect. This, then, is not good farming, because there is no profit. It is not very bad farming, because there is no loss. It is a favourable specimen of amateur farming, because the amusement costs nothing. This is an instance founded on existing prices; and the circumstance that it turns out about a drawn game renders it, perhaps, the more suited to our purpose, because it places in the simplest form before our readers the only elements on which success depends—the cost of the operation and the value of the increased produce. If Peruvian guano should fall fifty per cent. (the market value of hay remaining constant), then, buying hay at a little above 30*s*. per ton, and selling it at 60*s*., we should enjoy a profitable trade. If guano should rise fifty per cent., buying at 90*s*. and selling it at 60*s*., we should be speedily ruined. And, on the other hand, guano remaining constant, variations in the market value of hay would produce corresponding results. If all the operations of high farming could be reduced to this simple form, there would be, no doubt, no dispute. The oracle from Auchness would have been silent; the *Times* would not have commissioned; Huxtable would not have preached; Porcius would not have grunted; Milne would not have reported; Pusey would not have moderated; and we should not have written this article. But unfortunately, the complications of high farming are very numerous and very difficult to define. We will only state two instances. Every agriculturist knows that a Dr. and Cr. account of all the stall-fed cattle in Great Britain would exhibit a large balance of loss. It is possible, though not very easy to determine, that the money which is lost on the bullock is received back with usury in the barley; but in the case of a progressive farm there will always be abundant scope for difference of opinion on the question, whether the balance which is lost at the banker's can be found in the land? Any man who undertakes to make a balance-sheet on either a progressive or on a retrogressive farm will find himself frequently at fault. The question of capital and revenue will constantly occur. He will find that it is as difficult to close the capital account of a farm as of a railway, and that the results of farming accounts, even if kept on the most approved models, may be very misleading guides, and require to be acted on with much caution and discrimination. Mr. Huxtable has given to us a pamphlet which has gone through many editions, and which we therefore suppose to have taken considerable hold of the public mind. He undertakes, *inter alia*, to show to British agriculturists how they may grow wheat with profit at 5*s.* per imperial bushel. Pressed by the difficulty of account of which we have spoken, he endeavours to present a simple case of buying manure and selling wheat attended by a satisfactory result:—

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* Few persons, except those who have both observed and thought accurately, are aware how much furrows impede the beneficial effects of draining. They entice the water to the place which has been last and most trodden by the horses, and last and most glazed by the plough, and where it has consequently most difficulty of ingress.

"I shall proceed now to apply the principles A and B to answer the question, 'Can wheat be grown profitably for 5*s.* per bushel?'

"In the first instance I shall take the most unfavourable case—that of growing wheat successively year after year upon the same field, the manure, ammonia, being all purchased. Here the problem will be, At what cost can a crop of thirty-two bushels per acre be raised on the average of seasons?

	Bushels.
Natural produce of the soil . . .	16
The straw, containing ½ per cent. of nitrogen of previous crop of 32 bushels, weighing 3200 lbs., will furnish by its decomposition in the soil 19 lbs. of ammonia, or	3½
12½ × 5 = 63 lbs. of ammonia will produce .	12½
Total . . .	32

"The present price of ammonia, whether in guano or sulphate of ammonia, is 6*d.* per lb.

"The field being free from couch, will require only one ploughing. The threshing is supposed to be performed by steam, at a cost of 1½*d.* per bushel. The horse-labour has been charged at the cost for which it can be done by hired horses in this neighbourhood.

"With these data, the cost of an acre of wheat will be as follows:—

	£	s.	d.
Rent, 1*l.*; tithes, 5*s.*; rates, 2*s.* 6*d.*; way-rate, 10*d.*	1	8	4
Ploughing, harrowing, drilling, crushing . .	1	0	0
Tradesmen's bills	0	5	0
Bird-keeping and hoeing	0	5	0
Reaping, 10*s.*; harvesting, 3*s.* 1*d.* . . .	0	13	1
Taking in rick for threshing and marketing .	0	4	10
Threshing 32 bushels at 1½*d.* per bushel . .	0	4	0
Seed, 2 bushels	0	10	0
62½ lbs. of ammonia, at 6*d.* . . .	1	11	3
Total	6	1	6

	£	s.	d.	
The produce, 32 bushels at 5*s.* .	8	0	0	
Expense of crop . . .	6	1	6	
For the interest on capital and profit	1	18	6	per acre.

"This particular case has been adduced, not certainly as an instance of good husbandry, for it is the very reverse, but as an illustration of the manner in which the true principles of agriculture should be applied."—*Present Prices, Seventh edition*, pp. 22, 23.

We neither admit nor deny that 16 bushels per acre is rightly taken as the "natural produce of the soil." We neither admit nor deny that 5 lbs. of ammonia will produce 1 bushel of wheat. We assume these points in order that we may investigate with Mr. Huxtable other matters connected with his account. We know no way in which a farmer can derive advantage from a didactic example except by applying it to his own case and trying how it will work. We will proceed to do so. We have come recently into the occupation of 100 acres of arable land, situated in a midland county. On 20 acres of it we should be very thankful to grow wheat profitably for 5*s.* per bushel. But in order to do so we must comply with Mr. Huxtable's conditions—"the field being free from couch." In this district we include under the name of twitch or quitch the whole class of perennial weeds whose roots do not descend below the depth of an ordinary ploughing. Well! on the 1st October, 1851, we will deliver to Mr. Huxtable this 20-acre field. He shall pay 28*s*. 4*d*. per acre (his own price) for rent, rates, and taxes; and on the 1st October, 1852, we will pay to him 6*l*. per acre if the field is " free from couch," and fit to receive seed-wheat on one ploughing, harrowing, drilling, and crushing. But we have other and even worse enemies than couch—coltsfoot, thistles, sow-thistles, bindweed, and other deep-rooted plants, penetrating far below the track of an ordinary plough, and far more difficult to *eradicate* than couch. We will cheerfully give Mr. Huxtable an additional 2*l*. per acre if he will restore our land to us free from these. We have a third enemy, and particularly to wheat—water. Our land is undrained, and lies on an impervious subsoil. Nothing less than drains 4 feet 6 inches deep and 12 yards apart (or something quite equivalent in cost), laid with pipes and collars, will effectually subdue this enemy. We will give Mr. Huxtable 4*l*. per acre to execute this work, and he will lose money by it. The land being so re-delivered to us freed from weeds and water, on October 1st, 1852, we think it not improbable that what Mr. Huxtable calls the natural produce of the land, that is, the quantity of wheat produced without the application of any manure, might be 16 bushels per acre, and we have Mr. Huxtable's ammonia and word for the other 16. So that in the year from October, 1852, to October, 1853, we shall, according to Mr. Huxtable's data, have laid out 6*l*. 1*s*. 6*d*., and shall have received 8*l*., and be consequently 1*l*. 18*s*. 6*d*. in pocket. What have we to set against this? First, 12*l*. for clearing and draining, on which we will charge 4 per cent., amounting to 9*s*. 6*d*. Then we must have capital, horses, ploughs, drills, carts, crushers, harrows, &c., a threshing-machine, and a steam-engine. We will not ask for the 16*l*. 5*s*. per acre which is employed by Mr. Rigden. We will not even require the 6*l*. per acre which, at present prices, Mr. Pusey thinks sufficient. We will be content, under the mode of cultivation assumed by Mr. Huxtable, with a modest 4*l.* per acre. In our own agricultural calculations we always charge 20 per cent. annually on horses, implements, and machinery, for interest, repair, and replacement. We see that at p. 31 of his pamphlet Mr. Huxtable allows 20 per cent. on horses and 15 per cent. on implements and machinery. We will adopt his lowest charge. Then what shall we say about management and overlooking, either by ourselves or by a paid substitute, on 100 acres of arable land? can we say less than 50*l.* per annum, or 10*s.* per acre? The account will therefore stand as follows:—

MR. HUXTABLE'S Plan of Growing Wheat at 5*s.* per bushel, and per Contra.

Dr.	£	*s.*	*d.*	*Cr.*	£	*s.*	*d.*
To interest on 12*l.*, at 4 per cent.	0	9	6	Surplus received in 1st year	1	18	6
To interest on 4*l.*, at 15 per cent.	0	12	0				
To Management	0	10	0				
To Balance	0	7	0				
Total	1	18	6	Total	1	18	6
				By surplus	0	7	0

Mr. Huxtable gives no reason why any subsequent year should be better than the first. We will give several why they should be much worse. We find therefore that, altogether setting aside profit, it will require thirty-four years to replace the 12*l.* which we have expended. We have adopted all Mr. Huxtable's data without believing in them; we have applied his illustration on his own terms to our case, and we are sorry to be obliged to inform him, with much respect, that he is of no use to us at all; he has not taught us to grow wheat with profit at 5*s.* per bushel. If any of our agricultural readers are fascinated with Mr. Huxtable's statement, we advise them to try our plan of applying his illustration fairly to their own case. We must go farther. We must prove to Mr. Huxtable, if he be reasonable, which we have no reason to doubt, that should he attempt to act on his own illustration, it will break down under him. He shall be a fortunate youth just popped into the occupation of land at 28*s*. 4*d*. per acre rent and taxes, free from couch, the natural produce of which is 16 bushels of wheat per acre. We will not inquire into the previous history of the land. Mr. Huxtable shall occupy it as he proposes, and at the end of the first year, when he has paid 10*s*. for management, and 12*s*. for interest, repairs, and replacement of implements, horses, and machinery, which payments he cannot escape, he will remain with 16*s*. 6*d*. in hand, and there we advise him to keep it, for it will soon be required. Does he think, that when for four or five years in succession he has grown a wheat crop with one ploughing, given as a seed-furrow in the months of October or November, with as much money expended in hoeing as it can claim from the charge "birdcatching and hoeing 5*s*." (for we are not told on what terms these two items associate), his land will still remain free from couch? How much of his precious ammonia will, after the first year, have been occupied in growing weeds and not wheat? To what amount will 32 bushels per acre have dwindled? Will the land in five years be anything but a mat of weeds? Will anything less than the accumulated sixteen-and-sixes restore it to its former state of purity? We really thought that growing successive corn crops had gone out of fashion even as an illustration. We hope that Mr. Huxtable will not think that we trespass on his province when we remind him—"Thorns also and thistles shall it bring forth to thee." "In the sweat of thy face shalt thou eat bread." He appears to us to propose to eat bread without the sweat of his face. He says this is "not certainly an instance of good husbandry." Certainly not, for it will not pay. But it is not even a good illustration, for it will not work. The land under this management will not produce permanently 32 bushels. After five years it might graze a donkey, but it would not grow wheat. We are bound, however, to admit that if, *in every-day farming*, 5 lbs. of ammonia, costing 2*s*. 6*d*., will produce a bushel of wheat,* worth at the present moment 4*s*. 9*d*., the fact is of great importance to agriculturists, and Mr. Huxtable has done well to bring it prominently before them by his widely-extended publication. Still we could not consider that, or any similar discovery, as a permanent source of more than average profit to a wheat-grower, because the general recognition of such a ratio would very shortly be followed either by a rise in the price of ammonia, or by a fall in the price of wheat.

Before we can apply Mr. Huxtable's illustrative account to another purpose which we contemplate, we must state the theory of manures which he, as do Mr. Pusey and others to some extent, recognises as established:—

1st. Nitrogen is the base of ammonia, into which, under ordinary farming circumstances, it converts itself by imbibing one-fourth of its own weight of hydrogen.

2nd. Ammonia is the *only* manure of *any* value in the growth of cereals.

Proved as follows:—

Fourteen tons of ordinary farm-yard and stable manure have been shown by analysis to contain two cwt. of ammonia.

Three contiguous pieces of land, in all respects similar, having been sown with wheat—No. 1, without manure; No. 2, fourteen tons farm-yard and stable dung; No. 3, two cwt. ammonia—the quantity of wheat produced by No. 2 and No. 3 was exactly equal, as were, of course, also their respective excesses over the produce of No. 1.

Therefore the carbonic and phosphoric contents of the fourteen tons of dung were of no value whatever in growing wheat, which, as far as phosphates are concerned, is strongly confirmed by the experiments given by Mr. Pusey at p. 5 of his pamphlet.

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* We are sorry to observe, that in the experiment stated by Mr. Pusey, p. 6, 8 lbs. of ammonia were required to produce a bushel of wheat—a woful inroad on our anticipated profits.

Neither are the mineral contents of the dung of any value; confirmed also by the experiment of burning fourteen tons dung, and applying the ashes to wheat growing, with a slight *prejudicial* effect.—*Pusey*, p. 5.

The bushel of wheat which refuses to be produced without the application of five lbs. of ammonia to the soil, and will receive no substitute, contains in itself and in its straw only two lbs. of ammonia, and is therefore a very "wasteful," "extravagant," "costly" plant, as are barley and oats.—*Huxtable*, pp. 19 and 28.

In the case of turnips. "The simple phosphorus, which did nothing for wheat, nearly equals the dung for turnips." "Ammonia single does harm."—*Pusey*, pp. 6 and 7. "The mineral theory equally fails," "the application of potash diminished the size of the bulbs" (p. 6); and so doubtful is the case of carbon, that Mr. Pusey, after speaking with much hesitation, sums up as follows:—"At present, however, we can only say that the three leading principles of manure are, 1st, ammonia; 2nd, phosphorus; and probably, 3rd, carbon."—p. 8.

But turnips, which refuse to be fed by ammonia, are "thrifty plants;" they, "from their own resources, add to the amount." One ton of swedes contains more than five lbs., and one ton of tops more than twelve lbs. of ammonia.—*Huxtable*, p. 35.

We know not how our readers feel, but we are in such a whirl, that, when we consider where we are and where we have been, we are doubtful whether we are not involving ourselves in a labyrinth instead of assisting others in finding their way out. Let us look back one moment. Few years have elapsed since all who held the established faith believed that carbon was the main essence of manure, that a supply of carbon to the soil was the secret of agricultural success. Then arose a great prophet—a really great man, in spite of one failure—who paraded before us the mineral contents of vegetables, and assured us, that if we supplied the soil with those mineral elements, the vegetables would find their organic elements for themselves. We all ran after him. But his doctrine came to a natural end, not by experiment, but by experience. The mineral elements of wheat were supplied to the soil, and the return in wheat was—nil. And so the mineral theory is gone. Now have arisen a marvellous flight of philosophers, Lawes, Gilbert, Way, Boussingault, Playfair, and others, who agree wonderfully in the main, and teach us, that ammonia is absolutely the *only* manure for cereals; that phosphorus is probably the only manure for turnips, and perhaps for the other legumina (but of this we are not certain); and that it is doubtful whether carbon be a manure at all. We cannot help remembering the old farmer, who broke into a momentary pause in an animated dissertation on alkalies, and carbonates, and silicates, with the blunt exclamation, "I' my opinion there 's nought like muck." And though we are by no means inclined to dispute, or even to doubt, that these philosophers have rightly established the singularly-varying appetites and antipathies of our cereals and legumina, we cannot forget, that, either by a wonderful chance or by a special providence, the refuse of these vegetables, taken almost indiscriminately, and the excrements of animals, taken in the same manner, form a compound in which every object of culture finds the elements necessary for its vigorous growth and perfection. And so universal—we had almost said so equal—is the benefit, that, after thousands of years of experience, practical farmers are not even yet agreed to what crop their home-made manure is most beneficially applied; and whereas one man bestows it on his wheat, another on his beans, and a third on his turnips; the fourth man lays it on his mowing land, to be, if we are to believe our modern instructors, exhausted by the sun, dissipated by the wind, and drenched by the rain. Strange as the statement may sound to some of our readers, we do not hesitate to oppose experience to philosophy and reason, and to declare our belief, that in no way is manure applied more effectually than in the manner last stated; by which we mean, that if the same quantity of manure which would increase a crop of wheat 50 per cent. be bestowed on the surface of a piece of upland meadow, it will increase the crop of hay in more than the same ratio. Well, then, and wisely, has Mr. Pusey summed up this part of his subject in the following sentence:—

"The mineral theory hastily adopted by Liebig has broken down; no other has taken place. Our best authority, Mr. Lawes, has established certainly so much, that, of the two active principles in manure, ammonia is specially suited to corn, phosphorus to turnips, and that turnips are probably benefited by the woody matter of straw. But vegetable chemistry, having no fixed truths of her own as to the sources from which plants derive their food, or the mode in which they appropriate it, is not advanced enough to lay down laws for farming, or sit in judgment on its established practices. Except Liebig's suggestion for dissolving bones, and Sir Robert Kane's for using flax-water as manure, I know no agricultural process arising out of chemical discovery. The more we value the labours of agricultural chemists, the more warmly we look forward, as I do, to their future progress, through the patient examination of existing practice, which is itself the accumulated and varied science of ages, the more we should discourage undue expectations of immediate advantage. It is a great mistake to suppose that men can be made farmers by teaching them doubtful chemistry. But are we, therefore, to abandon agricultural chemistry because it is yet doubtful, and has not yet brought forth more fruit? Rather let those who are able cultivate it the more diligently by careful experiments, that, step by step, we may reach more certain knowledge hereafter. No one, meanwhile, can doubt the high value of Mr. Lawes's experiments in the field, or Mr. Way's researches in the laboratory."—*Pusey*, p. 14.

Perhaps, however, a ray of philosophic light, to which Mr. Pusey has adverted, breaks through the mist with which we are environed, and enables us to assign a reason for the faith in alternate husbandry which experience has engrafted in our minds. When manure is applied to a crop of turnips,they appropriate the phosphorus which it contains, but, for some unaccountable reason, refuse to touch the ammonia. (We use the word unaccountable, because, according to Mr. Huxtable, a crop of 32 bushels of wheat contains only in grain and straw 96 lbs. of ammonia, whereas 20 tons of turnips and tops, which he seems to consider to be an equivalent crop, contain 174 lbs.—p. 35.) The ammonia, therefore, remains in the soil ready to nourish the cereal crop which will so appropriately follow. If, *vice versâ*, the manure be applied to the wheat, that grain will appropriate or "waste" (*Huxtable*) the ammonia which it contains, leaving the phosphorus untouched and ready to nourish the succeeding crop of turnips.

Mr. Huxtable, however, feels none of the doubt and hesitation which so much perplex Mr. Pusey. He weighs out his equivalents; 5 lbs. of ammonia on the one hand, and a bushel of wheat on the other, with exactly the same confidence with which he would put a sovereign into one scale and two half sovereigns into the other. In the illustrative account on which we have commented, Mr. Huxtable bought his ammonia from the drysalter, but he says that he can manufacture it cheaper. The digestive organs of animals, principally pigs, are his laboratory. Here we find ourselves unwillingly, but, in order to avoid constant explanations, compelled to adopt a new term—nitrogen; and we must beg our readers to bear in mind, that, in all the operations of which we are about to speak, nitrogen, without any act of man, converts itself into ammonia, adding to itself at the same time one-fourth of its previous weight: so that when we speak of manure, four of nitrogen is five of ammonia. Mr. Huxtable lays down this proposition, that if you give to an animal food containing nitrogen, one fourth of that substance will be appropriated to his carcass, and the other three-fourths will pass away in his excrements (pp. 19, 20): he, however, suggests at p. 23 that the quantity appropriated to carcass is a constant quantity (3 lbs. in 100 lbs. of flesh), and by no means dependant on the amount of nitrogen in the food: and we deduce from his figures, that, if a pig be fed wholly on barley meal, he will appropriate a third of the nitrogen which it contains to carcass, leaving only two-thirds in the manure; whereas, if he is fed on beans and lentils, he will appropriate to carcass hardly more than one-sixth, leaving nearly five-sixths in the manure. This is a most important variation, as we shall see by-and-by; and indeed Mr. Huxtable himself is of opinion, that by neglecting this difference he lost 20*l.* in one porcine transaction of only 211*l.* 10*s.* We must, however, let this hare sit for the present, having first given our readers a specimen of the fearless way in which our author draws his conclusions:—

"Therefore, if we know how much nitrogen there is in the food given to a beast, and know how much he has increased in live weight upon that food, then, as each 100 lbs. of live weight contains 3 lbs. of the nitrogen, we can estimate how much nitrogen and therefore how much ammonia is contained in the manure: in other words, we can pronounce how many bushels of wheat that manure will grow."—*Seventh edition*, p. 20.

There is no waste here.

We must now pass to another, but ancillary, class of Mr. Huxtable's statements. He gives us (p. 26) a detailed account of an experiment in manufacturing pork, which was of sufficient extent as well as duration to be entitled to much weight. We do not perceive in it the elements of uncertainty which have been suspected by others. We believe the proportion between dead weight and live weight, which he assumes, to be well established and not to be stated too high. The important result is, that 5½ lbs. of dry food, being about four-fifths mixed meals, and one-fifth bran and pollard, will make one pound of swine's flesh. We believe that, on an average of English markets, the value of this 5½ lbs. of food would be 4*d.*, and that, on a like average, the value of a bacon hog is 4*d.* per lb. It is somewhat singular, that, in the case of an ox stated at p. 20, if we reckon his food at the present market price, he will have cost 4½*d.* per lb., which would be about his value in an average English market. In both these transactions, therefore, the feeder must seek in the manure, interest of capital, risk or insurance, attendance, expenses of marketing, and profit. If this be so, how important the manure is, and how important it is to use nitrogenous food, and how important it would be to discover a breed of animals generous enough not to appropriate any nitrogen, which, after all, is but 3 per cent. of their live weight! That is the great desideratum in agriculture. "Thus, in the preceding experiment, if the *meal*, instead of being half barley, had consisted wholly of beans or lentils, of which the nitrogen is about 4 per cent., the manure would have contained 500 lbs. more of ammonia; or, according to the rate of ammonia in our estimate, have supplied the essential materials for 100 more bushels of wheat." Assuming, therefore, that the food and the pork balance one another, a more favourable result than we could exhibit on the average of 20 years of pig-feeding, a summary of the account framed on Mr. Huxtable's data will stand thus:—from 1704 lbs. nitrogen given in food, deduct 434 lbs. sold to the butcher; there remain 1270 lbs. = 1524 lbs. ammonia = 305 bushels of wheat; to which add 100 bushels lost by the error of using barley *vice* beans, and the grand total is 405 bushels of wheat created by feeding an average of 80 pigs for about six months. Mr. Huxtable arrives within 5 bushels of the same conclusion by a less simple process. But we own that he is too fast for us. We cannot follow him. His calculations are all made *in vacuo*, without any allowance for resistance of the air or for friction. And yet he tells us that Ammonia, the object of his fond admiration, is the most volatile creature alive —that she will elope with anybody, and is sorely in need of protection (p. 21). He talks a great deal about fixing her, but he leaves us quite behind. We have no idea what he proposes to do to her, or how she would act if she were fixed. We are much consoled by finding (*Pusey*, p. 8—10) that the accomplished editor of the "Royal Agricultural Journal" is as much perplexed as ourselves.

We must now bring back our readers to the point from which we started, and must remind them that Mr. Huxtable has stated that ammonia is too dear at 6*d*. per lb., and that he can manufacture it for less. We are examining whether he has done so. We have been obliged, by the state of the markets, to cut down the price of his pork from 5*d*. and 4½*d*. to 4*d*., because neither in this year nor in the last has the price of bacon hogs been more than 4*d*. per lb. in the average markets of England. This, by his own statement, leaves his pork just evenhanded with his food. Though we accept with perfect confidence Mr. Huxtable's statements, we do not, as our readers will have perceived, confide in his deductions; but for the purposes of this investigation we accept them all. Mr. Huxtable, having bought his pigs and sold them, having paid interest on the money employed, and insurance on the pigs, having *lodged* never less than 70, and sometimes 90, having *cooked* for them, having cleaned them, we suppose rung them; having tended them in sickness and in health, having done all this for more than six months, has, at the end of that time, by his own showing, received, for doing it all, 1524 lbs. of ammonia, worth, at 6*d*. per lb., 38*l*. 2*s*. Has his ammonia cost him less than 6*d*. per lb.? We believe that on any fair charge for the particulars which we have stated, on any fair return on the buildings and apparatus necessary for lodging and feeding from 70 to 90 pigs, it has cost him more; and that even the additional 500 lbs. which he says that he ought to have got, but which he did not get, would fail to bring down the ammonia to the price at which he buys it from the drysalter. Having, therefore, before shown that he cannot, by buying ammonia, grow wheat to profit at 5*s*. per bushel, we have now shown that neither can he do so by manufacturing it.

We need not follow Mr. Huxtable into his calculations of the feeding value of his turnips. Mr. Curwen, Mr. Boxwell, and Mr. Howden, may be quite right when they estimate that a certain weight of clover and turnips will produce so much live weight in an animal, but we apprehend that Mr. Huxtable is quite wrong when he reduces that live weight into beef by the tables, and reckons that beef at the highest market price. Beef varies at this moment in Smithfield market from 3½*d*. to 5½*d*. per lb.; and we apprehend that twelve pounds of beef, made by a ton of yellow turnips, would be estimated there at the former figure, which would sadly derange Mr. Huxtable's calculations. This, however, we may remark, though it is worth but a passing sentence, that if it is bad to farm with our instructor on the plan of either buying or manufacturing ammonia, it is worse to farm with him without doing either; for in the latter case we must deduct from the debtor account the price of 62½ lbs. of ammonia, and perhaps 5*s*. from threshing and harvesting; and from the creditor 12½ bushels of wheat, leaving the balance in hand 12*s*. 6*d*. (or, if the wheat be reckoned at the present price of 4*s*. 9*d*. per bushel, 7*s*. 4½*d*.) to pay interest of capital and profit on an acre of wheat grown on land free from couch, and ready to receive the seed on a single ploughing. Never before were we conducted by an agricultural instructor to so complete a *reductio ad absurdum*.

Even if our investigation of Mr. Huxtable's accounts had been more favourable to his views, we must have protested altogether against the basis on which they are founded. He starts with an ideal farm, a farm the whole of which is free from couch, and ready to bear wheat with one ploughing, and yet the occupier has no capital *in* the land. The previous history of the farm is considered to have nothing to do with the matter. Our objection is, that such farms do not exist. No man can take such an one; and to an occupier who has brought one into that state, a notice to quit without compensation would be a sentence of ruin.

Though we have examined Mr. Huxtable's estimates strictly, and have differed from him freely, we must not allow him to suppose that we are insensible to the services which he has rendered to agriculture. His mind is full of knowledge, and his style of writing is clear and lively. Almost every page in his book conveys information, or suggests useful reflection. The manner in which, at p. 31, he systematises the general cost of cultivation, under the three heads of motive power, manual labour, and rent and charges, is the best which we have ever met with. The severest sentence which we should be justified in passing on his present performance is, that the cheerful and ardent spirit in which he pursues useful and benevolent objects, is not unlikely to involve those who accompany him in a somewhat dangerous fascination. We have much pleasure in bringing before our readers the testimony which Mr. Milne, one of his fellow-labourers in the field of agricultural literature, bears to his worth:—

"Mr. Huxtable is clergyman of the parish in which his farms are situated. I do not believe that there are many clergymen in the English Church, or in any Church, more devoted to their professional duties, or more successful in the discharge of them, than he is. In proof of this remark, it need only be mentioned, that, shortly after his appointment as rector of the parish, finding that the parish church was in a very dilapidated condition, and that it was difficult or impossible, from the state of the law, to get it properly repaired or replaced by another, he erected a new parish church entirely at his own expense. Moreover, by the handsome style of architecture adopted, and in the neatness of the interior fittings and furnishings, he still further indicated the homage which he wished to render to the Master in whose service he labours. He has established Sabbath-schools, to which, besides preaching twice every Sunday, he assiduously attends. Among the adult population of his parish, who, in their younger days, had not the benefit of the schools since established, he endeavours to supply the deficiencies of education by pecuniary rewards; for the Dorsetshire labourers are excessively ignorant, not one in twelve, as I learned from a well-informed proprietor in that county, being able to read. It was from the same benevolence which dictated these efforts and sacrifices, that Mr. Huxtable was led to think of, and take up the business of farming, that he might have the means of giving regular employment and good wages to the able-bodied labourers of his parish.

"From what has been said as to Mr. Huxtable's many parochial duties, it will at once be inferred that he does not superintend or direct the operations on his farms, as one would do who has nothing else to attend to. Days frequently elapse without his being on either of them, and hence the expense of management is necessarily greater than usual, especially on farms so small in extent."—Pp. 36, 37.

Mr. Milne's very interesting pamphlet contains an account of his visit to the farms of Mr. Rigden (Sussex), Mr. Huxtable (Dorset), and Mr. Morton (Gloucester). An abstract worthy of the publication would be very instructive, but we cannot attempt it, partly because space forbids, and partly because it deals rather with the practices than with the pecuniary results of high farming. Some of the particulars, however, with which we are made acquainted are intimately connected with the latter subject. Many of our readers will be surprised to learn that these farms occupy a capital of 16*l.* 5*s.*, 16*l.*, and 12*l.* per acre respectively.

With respect to Mr. Rigden's farm, we learn that on the side of expenditure the acreable charge amounted at Martinmas, 1849, within small fractions, to the following sums:—rent and taxes, 2*l.*; tradesmen's bills, 9*s.* 6*d.*; insurance, losses, and sundries, 2*s.* 6*d.*; wages, 2*l.* 8*d.*; purchased manures (including an allowance on purchased food), 1*l.*, and seeds 3*s.* 9*d.*: the whole amounting to 4529*l.* "The value of the total produce, on an average of the last two or three years, Mr. Rigden estimates at 9*l.* per acre"—amounting to 6660*l.* (now of course considerably reduced by a further fall of prices), and leaving a balance of 2131*l.* From this gross produce the following items must be deducted:—1st, the value of the portion consumed in the business of the farm; and, 2nd, the interest of 12,000*l.*, a considerable portion of which being invested in farm-horses, implements, furniture, &c., ought, for interest, repair, and replacement, to give a return of from 15 to 20 per cent. We have worked out this sum by the aid of the best agricultural accounts which we know to have been published, and of our own experience. We could not give the particulars without defending them by more minute explanations than would be suited to these pages; but we can assure our readers that they do not present a gaudy result. The impression produced on our mind is, that in no other business, with which we are acquainted, would Mr. Rigden's great intelligence and enterprise, and large capital, have met with a less adequate reward. Mr. Rigden is a very high farmer. His practice is, of course, in some degree modified by his contiguity to a large town. Having seen a portion of his farm last year, we are now confirmed by Mr. Milne's account in the impression which was then produced on our minds—that nothing which can conduce to success is either omitted or misapplied. In this case the extra manure is for the most part purchased, not manufactured on the farm. Mr. Rigden has the advantage of getting quite 25 per cent. more than the ordinary rural price for the milk of 21 cows, and of selling 50 acres (one-fifteenth of the extent of his farm) of potatoes on the ground. He has this further advantage to an arable farmer, that, except against a railway, he has not a fence on his farm. He had one hedge, but he grubbed it up.

We now come to the much-controverted case of Auchness, in the county of Wigton. It lies in a nutshell: 240 acres—rent under 22*s.* per acre; as far as appears in the account, subject to no charge for tithe or tax. *If this be so*, Auchness, transported into the parish of Sutton Waldron, and subjected to Mr. Huxtable's charge of 8*s.* 6*d.* per acre for tithe and tax, would yield a landlord's rent of 13*s.* 6*d.* per acre, of which it appears that 7*s.* 6*d.* is interest of money laid out in draining and extra building. This poor farm has been forced by admirable management to the extraordinary gross produce of 2518*l.* 15*s.* annually, or about 10*l.* 9*s.* per acre.

Gross produce		£2518 15
Debited with rent . . .	£262	1205 0
„ labour . .	417	
Purchased food and manures .	526	
It leaves a balance of . .		£1818 15

to pay for the portion of the produce consumed in the operations of the farm, tradesmen's bills, interest of money, incidental expenses, and profit. The gross produce approaches very nearly to ten rents. Though the labour is 8*s.* per acre less than Mr. Rigden's (the difference perhaps arising from the rate of wages, which are very high near Brighton), the farming at Auchness is in many respects higher than at Hove. At the former place the purchased manures and cattle food amount to nearly 44*s.* 6*d.* per acre, whereas at the latter they are only 21*s.* 6*d.* The gross produce at Auchness exceeds that at Hove by 29*s.* per acre, being 6*s.* per acre more than the excess of purchased manure and food. The peculiar advantages of the farm at Auchness appear to be, that it lies at a low elevation, near a good shipping port, has water-power, ample and convenient buildings, a climate singularly suited to green crops, an unlimited supply of peat, and 500 cart-loads annually of seed-weed for the manufacture of manure. The surprising produce appears to result mainly from management of cattle and manure, very superior to what is ordinary, but anywhere attainable by the combined efforts of landlord and tenant, and from the devotion of nearly one-fourth of the farm to the potato crop. We lay little stress on the latter circumstance. A man as enterprising and as intelligent as Mr. McCulloch will always find some crop particularly suited to his locality and tenure. It may be potatoes, or carrots, or parsnips, or chicory, or woad, or teazles, or flax. We once knew a man who on a very high and poor farm made money by growing chamomile. The man, not the place, produces such results. Mr. Caird gives us no statement of the capital employed by the tenant of Auchness, nor any figures which enable us to come nearer to a balance than the account which we have laid before our readers: but we see no reason to doubt that Auchness is an instance of good farming—that it pays well. Our decided opinion is, that if all the landlords in Great Britain were like Colonel M'Douall of Logan; if they had farms having the advantages of Auchness, tythe and tax free, which they were willing to let at 14*s.* per acre; and if moreover they were willing and prepared to lay out eight or nine rents on the farm, receiving 4 per cent. return; their tenants, as skilful and as highly qualified in all respects as Mr. David McCulloch, might farm high with much confidence, even at present prices, and find high farming *good.* We cannot expect this to take place at once, but in the meanwhile there is a great deal in Mr. Caird's description of Auchness well worthy the attention and imitation both of landlords and tenants.

We fear that our readers will not consider that our account of High Farming is on the whole very cheerful; but our account of ordinary arable farming will be still less so. Before, however, we come to the latter subject, we must hear what the editor of the "Royal Agricultural Journal" says on the former.

Mr. Pusey's pamphlet is a most valuable contribution to agricultural literature. It is also most timely, and every way worthy of the position and character of the editor of the leading agricultural journal of the empire. Assuming the existing difficulties of agriculture without dilating on them, glancing fairly and candidly at the alleviating circumstances by which a large fall in the price of produce has been accompanied, he applies his main efforts to bringing pointedly before owners and occupiers of land the remedies which are offered to them by science and by experience, and which are consequently quite within their own power. These remedies he ranges systematically under a number of heads, of which some, having reference to permanent improvements, are addressed more particularly to owners, and others, which relate to recurring culture, to occupiers of land. He is a great master of condensation. Forty lines of what he calls introductory remarks explain and vindicate his whole purpose and plan, and already in the second page he is deep in the mysteries of vegetable chemistry. Into these we have been led incidentally in treating of Mr. Huxtable's propositions. Animal chemistry is discussed in three pages singularly lucid and comprehensive. Probably some of the following propositions may be new to our readers. Vegetable nutrition is darker than animal, because "vegetables have the task of transmuting dead elements into living matter," and the "hidden powers" by which they work are yet undiscovered; but animals find their "substance ready made in the vegetables which they consume," their "stomachs do not compound their flesh from the ingredients of their food, but, finding that flesh ready formed in the corn or hay, merely select and appropriate it." Gluten, albumen, fibrine, flesh, muscle, blood, are "exactly the same body," "never vary in composition," "quite identical." When an animal eats food containing gluten and carbon, he burns the carbon to keep himself warm, and builds up the gluten into "flesh without change, just as a house is built up with stones from a quarry." All animals desire food containing carbon in cold weather, and reject it in warm, "as we light our fires at Michaelmas, and leave our grates empty in May." So far there is a delightful concord among all the authorities, and by these rules we may proceed to build up lean meat with great confidence. But when we come to fat, Liebig, Playfair, and Boussingault have each a theory of his own. We shall imitate Mr. Pusey's prudent reserve in expressing no opinion on their differences. We certainly have been startled by the proposition that mangold-wurzel contains very little fat or milk, which substances are contained more abundantly in straw; and, as our own cattle have always fed faster and milked better on mangold-wurzel than on any other vegetable food, we cordially agree in Boussingault's candid admission, that "practice has got the start of theory; and I own, with perfect humility, that I think its conclusions are in general greatly to be preferred."

Passing from chemical to mechanical science, Mr. Pusey lingers somewhat incongruously with meteorology by the way, and declares his belief that the climate of England is the best in the world for farming. The only important deductions, however, which he draws from a considerable array of meteorological facts, and from an isothermal map of the world, are, that though draining pipes of one inch diameter may be sufficient in a county where the annual fall of rain is only 25 inches, they may be quite inadequate in another where the fall is 50 inches; and that manure may be much less injured by rain in an open fold-yard in the former county than in the latter; in both which conclusions we have no doubt that our candid readers will cordially concur.

Mr. Pusey puts forth his full strength when he impresses upon farmers the immense advantages which mechanics have conferred upon agriculture, and he accuses them, temperately but firmly, of having been slow to avail themselves of those advantages. He estimates a saving in motive power, as represented by horses, "putting the expense of each horse at only 10*l.* a-year," of 750,000*l.* annually since 1840; and this arising from the only partial adoption of the improved implements which agricultural shows have brought under every one's observation. In the case of carriages he proves that the economy in capital is even greater than the economy in operation, for, whereas on a farm of 200 acres they would cost under *the old* system 161*l.*, they are amply furnished under the new for 57*l.* 10*s.* "To use them" (the old carriages) "still, is like running a stage-coach in these days between London and Bath." He next adverts to the increased use of agricultural steam-engines, and to their greatly-diminished consumption of fuel. He calculates the saving by the employment of the best threshing-machines, as compared with threshing by hand, to be 7*s.* per acre on wheat; and states that they will perform double the work of ordinary machines which are still in general use; "a difference which could not exist two years at Manchester,"—a very apt illustration, for we have heard it said that every successful cotton-spinner of old standing has broken up or burnt his machinery two or three times in the course of his career. Mr. Pusey says that he will never incur the expense of barning another rick before threshing it, and hints at dispensing with barns altogether. We do not know whether he means to risk rain when threshing. He lives in the driest county in England. We should not be disposed to be so adventurous, but we are inclined to think that barns are not unlikely to be in some measure superseded by covered stack-yards, built on pillars, and covered perhaps with corrugated iron. In a small pamphlet, entitled "On the Construction of Farm-Buildings in Ireland" (W. S. Orr and Co., London and Liverpool), this plan is advocated, and detailed estimates are given of the expense. The writer justly says:—

"The use of the covered stack-yard is not only a shelter to the produce, but a considerable saving in the expense of stacking and thatching. These operations have to be carried on in the busiest season of the year, when labour is dearest; and the after expense of pulling the hay-rick is a waste of material and loss of money. In the covered stack-yard these objections do not exist; the ricks are formed as fast as the carts can be unloaded, and a cloudy sky or a threatening horizon does not frighten or injure the farmer in the middle of his stacking operations."

From threshing, the transition is easy to cutting up the "loose straw into chaff," for which operation Mr. Pusey was wont to pay 2*d.* per six-bushel basket. He now, by means of Mr. Corue's chaff-cutter, performs the same amount of work for one farthing, "one-eighth only therefore of the cost incurred here twelve years ago." Mr. Pusey may be sanguine in his calculation of these savings, but we quite agree with him that mechanical science has conferred greater advantages on agriculture than chemical. It may be doubtful whether the latter has materially increased the amount, but there can be no doubt that the former has very materially diminished the cost of production. "But," says Mr. Pusey, "farmers have been, to say the least, rather slow." The cost of motive power,—the cumbrous wagon and slow horses, always favourites with the wagoner because they allow him to be slow also,—the ill-constructed plough, a favourite with the ploughman because it lightens his labour a little by increasing that of his horses a great deal,—are year by year pulling down the old-fashioned arable farmers of the midland and western counties. Nothing can save a man who goes slow when all the rest of the world is going fast.

Hitherto Mr. Pusey has addressed himself to occupiers of land. He now introduces his advice to owners, with the following observations:—

"Ten years since nothing struck me so much as the varied means possessed by the owners of land in England for raising, permanently, the productiveness of their estates. In no country are those means so various. Scotland and

Flanders are monotonous in contrast with England. In none has so much been effected. And after ten years' labour the same thing still strikes me as forcibly. It is on these recognised practical improvements that our dependence, I firmly believe, must be now placed. Not only, too, have we these *varied* means, but most of them are very *cheap* means. They would average three or four pounds an acre, and the crops are increased by them, be it remembered, without increase of the tenant's outlay. I know no other safe investment in which moderate expense produces so large a result of *profit* as in many of these permanent improvements of land. At the present time, however, the landlord's anxiety is, to avoid permanent *loss* of income. He should, therefore, raise the productive power of each farm, and there are very few farms on which the owner, consulting with the tenant, may not find some effective and cheap improvements to make."—*Pusey*, pp. 22, 23.

The improvement of land is then ranged under twelve heads, of which some are of general, some of local, and two or three, we think, of rather questionable application. Draining stands first in the list, and we are far from questioning the propriety of its precedence. But before we proceed farther, we must make a professional appeal to the editor of the "Royal Agricultural Journal." We do so because, in the matter to which we refer, he has more power than any other person; and though we shall interrupt the current of our ideas, and the thread of our discourse, we cannot consent to hide our appeal in the obscurity of a note. We seldom read a paper in the Journal, or in any other agricultural publication, without encountering some local term or phrase with which we are wholly unacquainted. We entreat the editor to reform the vocabulary of agriculture, first by his own practice, and then by his influence. We appeal from Mr. Pusey to the editor. Mr. Pusey states the depth of his drains in feet and inches, and the intervals in yards and feet, but he states the length in poles. Why this should be, unless it has some sly reference to the difficulty of ascertaining the longitude, we cannot conceive. We have no idea what a pole is. Perhaps the length of Mr. Pusey's walking-stick, or some personal measure. Perhaps *he* does not know that a rood of draining in Leicestershire and Derbyshire is seven yards, and in Staffordshire eight; and that if you leave out one of the *o*'s in this measure, you cut down the length to five yards and a half. With respect to the words "inch," "foot," and "yard," there is no such uncertainty of interpretation. They convey to the minds of every one of Her Majesty's British subjects a definite and an unvarying meaning. Again Mr. Pusey talks of bushels and quarters of lime. We believe that we are the largest lime-burners in England, but we do not know what quantities these terms indicate. We occasionally burn lumps of lime which would not go into a bushel. Though cwts. and tons do unfortunately, in respect to a few articles and in a few localities, refuse to conform to the definite meaning to which they are confined by Act of Parliament; and though we admit that, in the north-western provinces, lime is one of the articles which, in passing from what mercantile men call first hands, declines to be cut down from 120 lbs. to 112, yet we believe that the use of the words tons and cwts. would, even with respect to it, convey much more general and more definite information than quarters and bushels.

Mais revenons. We wish we could consider draining to be one of "the very *cheap* means" of improvement which Mr. Pusey indicates. We have never found it so. He gives us a table of the prices which he pays for draining. We cannot estimate the price of labour per yard, because we do not know the length of Mr. Pusey's pole; but a cost per acre of only 2*l.* 5*s.* 7*d.* for five-feet drains and 11⅝-yard intervals, is by us perfectly inexplicable. Nor can we understand how five-feet depths with these intervals should cost only 3*s.* 4*d.* per statute acre more than four-feet depths. The cost of 17*s.* 3*d.* per acre for pipes is only explicable on the supposition that they are small and used without collars, a mode of draining which we would hardly thank any one to execute for us gratis. With extended experience we adhere to a statement which we made two years ago in this Journal:—"We do not think that we ever saw so favourable a combination of circumstances, that efficient thorough-draining of retentive land could be executed at from four to five feet deep under 4*l.* per acre. We have seen few or no cases in which it might not be executed for 5*l.*" We cordially agree with Mr. Pusey, that, "instead of saying that a whole farm," or a whole field, should be drained at a stated interval, you should "unfold your plan as you proceed." We agree, with the same cordiality, that to prescribe the same depths and the same intervals for all lands, is perfectly empirical. But when Mr. Pusey says—"a line of wetness may be found on a hill-side where the springs are thrown out, oozing through" (we should have thought, running over) "the field below—draw your drain deeply along this line"—we differ from him entirely. We never saw an instance in which such a case was encountered most cheaply or most effectually in the manner prescribed. We dissent for the following reasons. The cause of the line of wetness is, that a porous stratum reposes on a retentive, and the water, which has sunk through the former, being unable to sink through the latter, bursts out to the day at their line of junction, or at some parts of it. But Nature is not studious to level her surfaces very accurately before she brings them into apposition, and therefore their various points of contact are seldom found to be exactly in the same plane. In order that the drain in the line of wetness may be effectual, it must pass below all the points of contact of the porous and retentive strata; it must in its whole length cut into the retentive stratum. If, therefore, on any given line, the average depth of the points of contact of the two surfaces being six feet, there is one place in which the depth is ten feet, the drain must be ten feet deep in its whole length. If it be not, the water passing, and at that lowest point with most freedom, under the drain, will appear at the surface on the land below. Add to this, the external line of junction between the two strata is seldom so straight or of so even curvature as to afford a desirable line for a drain. If, on the other hand, an experienced drainer examines the surface, he will always be able to discover the lowest point or points of contact between the two strata; we mean lowest with respect to the slope of the hill. If into that lowest point or points he drives, up the line of steepest descent, an adequate drain or drains, he will so lower the level of the water which stands in the porous stratum, that it will cease to flow over the edge of the retentive, which is the evil to be remedied. If a stream of water enters into a barrel with an open top, it will flow over the rim or over some one or more low places in it. But if you bore into the barrel, a foot below the rim, a hole or holes of sufficient capacity, the water will then cease to flow over, and the barrel for a foot below the rim will become dry. We have been diffuse on this point, because we have seen many instances of well-executed drains, drawn along the line of wetness, which have been ineffectual, and because we know no theory, deserving to be exploded, which lingers more pertinaciously than that of the line between wet and dry. Mr. Pusey mentions an instance in which by a ditch which cost 20*l.* he drained forty acres of land. We have seen a case of "line of wetness" in which one drain, driven in the steepest slope four feet deep increased to seven in the last twenty yards, effectually stopped a flow of water over nine acres of land, four of which did not belong to the person who executed the drain. We quite admit, though we do not know from what source Mr. Pusey derives the maxim, that "one drain well laid to suit the circumstances will often save a dozen by rule," and generally that it is much more satisfactory to drain by force of head than by force of money.

Still, whenever Mr. Pusey writes on draining we desiderate the recognition of what appears to us to be one great if not indeed the main object—the preparation of the land to receive and *admit* all the rain which may fall upon it. On well-drained land this preparation is always in progress, or at least effectually progresses until it has been effectually attained. Nature has only two ways of drying the surface of retentive lands—one, the great atmospheric drain, evaporation—the other, the drain by vegetation. In winter both these are in abeyance; and the consequence is, that when such lands at that season become saturated with water, they continue so till those natural drains begin to act again. When rain falls on land in this saturated state there is no admittance; the house is full, the inmates are three in a bed already; the vagrant must pass on to some other asylum, and he always takes anything which he can carry away with him. But when such land is well drained, every drop of water which runs out of the drain leaves room for a drop to enter at the surface; every hour of fair weather prepares for an hour of rain. The vital difference between four-feet drains and two-feet is, that the constant tendency of the former is to have nearly four feet of soil prepared for the reception of rain, whereas the latter can only prepare something less than two feet. Every one knows that the effect of open ditches and of straightened watercourses has been to increase the rapidity with which our floods rise, and to limit their duration, with the concomitant result, that the streams carry down much more mud with them. The effect of general under-draining would be to reverse both these results. Rain falling on soil ready to receive it, and filtered through, would pass off much more equably, and would carry away with it no impurities. With us, the last fortnight of January and the first of February passed without downfall. Our drains, on retentive lands, ceased to run. Then came a heavy fall of rain. The ditches of our neighbours on undrained lands ran full and very muddy: our drains ran equably and quite clear water. After four days of light frost our neighbours' ditches ceased to run, but our drains continued for a fortnight, and were running gently when more rain came. These matters are worth observation.

Having appealed to the editor of the "Royal Agricultural Journal" on one subject, we will now take the liberty of appealing to its correspondents on another. We have no doubt that some one or more of them are quite competent to furnish information which would be of great value to drainers. We want a table which will show at one glance the water-passing power of pipes at various degrees of inclination—something of the following sort:—

Fall in 10 yds.	Size of pipe.	Water passed per minute.
1 inch .	. 3 inches .	. x gallons.
2 ,, .	. ,, .	. n ,,
3 ,, .	. ,, .	. m ,,

and so for every size of pipe commonly used up to the sharpest fall, say four or five inches in a yard, which is likely to occur in agricultural drainage. There is no use in providing for extreme cases. The table might be so arranged as to indicate at what respective inclinations the various-sized pipes become equal to one another in water-passing power. We shall feel an additional obligation, if the gentleman who is so kind as to undertake this will abstain from using any learned phrases, such as "subtending angles," and so forth. We know nothing which is usually determined more by a random guess than the size of pipes in a receiving drain. To say so many acres to so many inches is nothing, unless we know the inclination.

We spare the admirers of the soft beauties of agricultural England the pain which they would experience in reading Mr. Pusey's denunciations of hedges and hedge-row timber. We hardly know whether this ruthless reformer would leave a hedge or a tree standing between John of Groat's and the Land's End. They are doomed. This is certainly a cheap improvement, for, when you have eradicated them, you are quite sure that the hedge cannot be there again for one ten years, nor the tree for a century. On this subject we will not trust ourselves, but will hand over Mr. Pusey to the tender mercies of William Johnston, barrister-at-law, who, in two volumes full of varied and useful information, has undertaken to hand down to posterity "England as it is in the Middle of the Nineteenth Century:"—

"One great charm in the general tone of the English landscape arises from the abundance of timber all over the face of the cultivated land. From one end of the civilized world to the other, the hedge-rows and hedge-row timber of England have been, and are, the admiration of the traveller. A great destruction of this timber is, however, now in progress, and it appears likely to increase. In order successfully to compete with foreign farmers, who are now as free to bring their produce into English markets as English farmers are, scientific agriculturists declare that it is expedient to make our fields larger and more open to sun and rain, by removing hedges and fences; that the shade of trees is injurious to the ripening of grain, and therefore that they should be removed; that timber-smothered land is a reproach to scientific and economical farming; that to keep pace with the advancement of agricultural knowledge, and to meet the activity and competition of the age, the hedge-rows, which have heretofore been considered the beauty of England, must, from considerations of utility, be abandoned; that land must be looked on as nothing else than a manufactory of agricultural produce; and that farmers who think of anything else than profit are little better than fools. Such are the theories of those who bring the wisdom of city counting-houses or scientific lecture-rooms to bear upon rural affairs."

But the case is more hopeless than even Mr. Johnston states it to be. The heartless wisdom which calculates that the hedges in one parish in Devonshire would have reached "from London to Edinburgh," and exults that they are now so much reduced that they would "stretch little farther than York"—which says, "The utter extinction of the land overshadowed by trees would be gladly submitted to by every farmer, provided the trees were to be annihilated, and that without any diminution of rent," —comes not from a scientific lecture-room, nor from a city counting-house, but from the Conservative M.P. for Berkshire and editor of the "Royal Agricultural Journal;" and the man who boasts that it is now a very long time since his own internal fences have been removed entirely, is the same individual.

Four-footed game are doomed also—another cheap improvement; but we are thankful to Mr. Pusey for tolerating pheasants and partridges. He reckons burning clay, claying, liming, boning, and chalking among cheap "landlords' improvements." No one of these operations is of general application. Perhaps situations may be found in which each of them may produce an improvement having somewhat of permanence. Nothing but local experience is a safe guide. Of lime, Mr. Pusey says, "it is considered indispensable on the west side of England, and is generally found utterly useless elsewhere." Of burning clay, we beg to state, that though he cites eight witnesses who all testify strongly in its favour, and though we do not at all doubt their testimony, our experience tells us that this practice also is only of local advantage. We have burnt clay in Staffordshire and Derbyshire, we have seen it burnt for several successive years on a large scale and at *vast* cost in the former county, and we never saw an instance in which it was followed by any apparent advantage, and we have seen several, where the surface of the land was burnt, in which the result was manifest deterioration. We state this, not to dissuade persons from proving the effect, but to caution them against practising on a large scale before they have proved it. We need not go far to find a gentleman whom the clay-burning papers in the "Agricultural Journal" have cost hundreds of pounds, which he might just as well have thrown into the Bay of Biscay.

Our great agricultural authority rivals Cato in his advocacy of water-meadows, but this with a limitation which will at once exclude half England, for he insists that the water shall be soft. We shall be obliged to him if he will reconcile the following statements, which we find at pp. 10 and 33 of his pamphlet:—"If you pour a solution of ammonia on loamy soil, the water, when it escapes below, will be free from ammonia." "Putrid urine, sewer-water, passing through loam, as Mr. Huxtable found, become pure as well as clear" (p. 10). "Our own pure and warm springs, issuing from the depths of the earth, fertilize our meadows by bringing with them ammonia, the result, perhaps, partly of ancient volcanic action, partly acquired by filtration through the upper soil, for in soil, too, even uncultivated soil, modern chemistry has recently detected ammonia" (p. 33). How is this? You pass water charged with ammonia through soil in order that it may leave its ammonia, and it does leave it; it comes out free. You take other water which has passed through soil, because it has picked up ammonia in its passage, and you pass it through other soil in order that it may leave this ammonia behind. Why should it leave on its second passage that which it has picked up on its first? There is some confusion here.

On the subject of farm-buildings Mr. Pusey speaks with his usual good sense and moderation. He is of opinion that the farmer should be as well lodged as the parson. But of the buildings he says, "A man with 3000*l.* set apart for the purpose might well be uncertain what plan to adopt. Notwithstanding the really excellent plans of farm-buildings we have recently published, for one I should certainly be puzzled; because farm steadings, like certain countries, are really in a state of revolution;" and always will be. We are about to erect buildings on an arable farm, and with a sparing use of bricks (now, however, much cheapened), we shall, with great care as to arrangement, use in the main larch poles and slabs. These will last twenty or thirty years, and at the time of their erection we shall plant a waste acre with larch or fir, which will come in for repairs, or for renewal, if in the meantime a better arrangement has been discovered. Moreover, we can now have a brickyard without being troubled by the visits of the exciseman, and in it we can make our own draining-tiles and pan-tiles for covering, if we find it expedient. By these means, instead of the 10*l.* which is often required, we expect to execute the work for 2*l.* or at most, 3*l.* per acre. It seems to us that, in our present state of knowledge as to the management of manure, whenever a farmer can command abundance of litter, or dried peat, or any other substitute, boxes for the feeding of cattle and lodging of horse, cheaply erected, and dispensing with liquid manure tanks and water-carts, or other arrangements for its distribution, afford the best and most economical plan; for we are quite of opinion with Mr. Pusey, that "liquid manure is a pretty toy, but solid dung is for farming in earnest." On half the farms with which we are acquainted, want of extent and permanence in the building is not the evil, but an arrangement which forbids economy and the prevention of waste; and we know many in which a fire once in half a century, if it had burnt the buildings only, would have been a benefit to the property. And this state of things is not peculiar to agriculture. What manufactory is there in England to which buildings erected half a century ago are not a nuisance, and an impediment to the successful prosecution of the concern? We are much too apt to attempt to impose our wisdom on succeeding generations. We see plans for making farm-buildings fire-proof. What can be more absurd than any considerable expense incurred for that object, when you must have such inflammable articles as straw and hay on the premises, and when a wheat-stack containing 100 quarters is, even at present prices, of more value than a barn or a stable? Low prices must, among other expedients, be met by an economy of dead capital.

The rest of Mr. Pusey's excellent treatise is devoted to what he calls "the practice of farming," and comes therefore only collaterally within our present scope. But, several pages on, "The Foulness of Land" has so intimate a connection with the expenses of cultivation, and Mr. Pusey's statements are so utterly opposed to our own experience, and to everything which we have ever seen stated by any other agricultural writer except Mr. Huxtable, that we cannot pass them by without notice. Mr. Pusey quotes from "Bayldon," a standard work, "the absolute expense" of fallowing an acre, "and his charge is estimated, be it observed, not for a field casually foul, but as a regular ingredient of the cost of the entire turnip crop of a farm every year." The absolute expense amounts to 2*l*. 9*s*. 6*d*. per acre. If to this be added the 28*s*. 6*d*. per acre for rent, tithe, and taxes, included in our proposal to Mr. Huxtable, the amount will be 3*l*. 18*s*. per acre. Our field is casually foul, fouler probably than the average land of England, when its turn comes to be fallowed. On the other hand, we are sure that land which has for a series of years been periodically subjected to Mr. Bayldon's fallow would be much less foul than the average. We do not, therefore, after having seen Mr. Bayldon's detailed estimate, repent of our charge of 6*l*. per acre for making a field casually foul "free from couch;" nor do we think that the additional 2*l*. for eradicating the deep-rooted weeds, whose existence Mr. Pusey completely ignores, is excessive. Every farmer knows that when a field is casually foul, or even of average midland and western county foulness, both these enemies cannot be destroyed by the fallow of one average summer. But Mr. Pusey proposes to strike out the whole of Mr. Bayldon's bill, except 8*s*., adding 1*s*. per acre on the following authority:—Mr. Hudson, of Castleacre, forks the couch out of his wheat stubbles at the expense of 1*s*. per acre, and sows his turnips with one ploughing, for which the above-named 8*s*. is allowed by Mr. Pusey. This is marvellous enough; but in farming, when any statement comes to us well authenticated, we accept it *as far as the instance in which it has occurred is concerned.* We know, however, that if this forking of couch were attempted on our wheat stubbles, or on the bulk of those over which our eye passes, the hardened surface would come up in lumps, and the couch, instead of being presented on the surface in the handsome form in which Mr. Pusey has presented it to us by a drawing, would be broken into short lengths, each imbedded in a hard lump of soil, and ready to sprout with the first rains of autumn, and could only be destroyed by "the ploughing, harrowing, rolling, raking, and burning, 'very likely' repeated a third time," which he so much deprecates. We know, further, that if we should attempt to grow turnips on one ploughing from a wheat stubble, we should never get a sufficiently tender tilth to ensure a plant. Oh! that Mr. Hudson and Mr. Bond could be our godfathers, and that, leaving 8*s*. for ploughing and 1*s*. for forking, we could "strike out at once the remainder of Mr. Bayldon's long bill, which will give a saving of 2*l*. per acre upon the turnip crop, that is, on one quarter of an arable farm; and as 1*l*. is the average rent of land in England, a saving of one-half the rent. Let no one hereafter speak of clean farming as expensive farming. What high farming may be remains to be seen. At all events, according to Mr. Bayldon, we have saved *two pounds* per acre to pay for artificial manure on our turnip crop, which we must hope will suffice."—*Pusey*, p. 47.

On his own farm Mr. Pusey allows only one pair of horses to one hundred acres of land—a lower estimate than we have seen elsewhere. He says, "I had a farm full of couch, and having now made it clean—" Happy man! But we long intensely to know at what cost of money and *of time* he made it clean. What capital of cleanness has he invested in the farm? What sum does it owe him annually for permanent interest on cleanness, or for gradual replacement of money? We want to know "what landlords and farmers ought to do," not on clean farms, but on average farms. Will he tell us what sum of money must be invested to make all the farms in England as clean as his own? He, a provident man, got landed in good times. We are still struggling in the slough, and want him to tell us how we are to get out. We admit, however, freely, though we differ with him sometimes, that he has done more to help us out than any man we know.

Passing on to other points of practice, Mr. Pusey takes frequent occasions of showing that the idle, the ignorant, and often even the parsimonious farmer is the "real spendthrift." He treats both of increase of produce and of reduction of expenses, and perhaps, on the whole, gives rather the greater prominence to the latter topic. This is at least an useful corrective to other agricultural publications, which have dwelt almost entirely on the former. We beg leave to convey to Mr. Pusey, with much respect, our sincere obligations. He opposed the late legislative changes which affected his order, and probably retains on that subject his old opinions: but he writes with admirable candour; and the unrepining and even hopeful spirit in which he treats of the prospects of agriculture, indicates the influence of a temper and of principles which it must be a happiness to any man to possess.

Mr. Pusey says that farming estimates of the expenses of cultivation are fanciful things; and often they are so. But there must be expenses, or there must be limits within which they can be estimated. We are sure that we could form an estimate which no man could prove to be excessive, but which would show that where an arable farmer grows only twenty bushels of wheat, thirty of barley, and forty of oats (gross produce at present prices about 4*l.* 4*s.* per acre)—and in this category would be included more than half the arable farmers in England—he must draw in many cases for the whole, and in all for a large portion of his rent, tithe, and taxes, either on his own capital or on the staple of his farm. Neither of these funds is likely to answer his drafts long. What then must be done? He can only improve his position in one of two ways; either by producing more at his present cost, or by producing his present quantity at less cost—or partly by the one and partly by the other. Produce can only be increased either by enabling your crops to avail themselves more fully of resources already existing in the soil—which is improved culture; or by adding resources to the soil—which is extra manuring; or partly by one and partly by the other. Improved culture is a leech, and tends to exhaustion. You have a horse going four miles an hour; you flog him, and he goes eight; but the next time you flog him he will only go six, and so every time in a diminishing ratio, till at last he will not go at all. If your whip is only sharp enough to increase his pace from four to six in the first instance, he will probably go a little longer, but will only traverse the same ground in the end. To this general rule there is, in practical husbandry, one important exception. To the extent to which the improved culture effects the extirpation of weeds, the cultivation crop may be increased without producing increased exhaustion. (We will have a word with Jethro Tull's new-fangled disciples, the spade-husbandry men, by-and-by.) Even if this view of the case be wrong, still the advantage of improved culture must be estimated by a balance between increased cost and increased produce. Extra manuring may be effected from two sources, either by purchasing manure directly, or by purchasing it circuitously, *i.e.* manufacturing it by the agency of cattle. In the latter case the manure is equally purchased, whether the cattle consume food expressly bought for them, or whether they consume what would otherwise have been sold. Which is the cheaper way of providing extra manure? That may be a question difficult to answer, because the cost in one case is fixed, and in the other variable. Our impression, rather than our opinion, is, that where a farmer is a *good buyer and a good seller*, where he has such an arrangement of buildings and such an apparatus as enable him to reduce the cost of preparation of food and of attendance on his cattle to a minimum, he will manufacture manure cheaper than he can buy it; but the contrary where one or more of these elements of success are wanting. We think, however, that the manufacturer plays on the whole the surer game; 1st, because he can be certain of the quality of his article; and, 2ndly, because we do not think that it is established beyond doubt that the light concentrated manure, on which he must mainly rely if he is a purchaser, will for a series of years maintain a farm at the same point of fertility as those which are manufactured by the old-fashioned organs of digestion. But the improvement of a farmer's position, either by purchasing manure or by manufacturing it, depends wholly on the balance between the cost of the manure and the value of the increased produce. He may make his position better, or he may make it worse. Fourpence per pound for ammonia may raise him; sixpence may depress him. Mr. Pusey, relying on the Rothamsted experiments, says that 18*s*. worth of guano will produce 40*s*. worth of wheat. We never found it so, or saw it so, in actual farming. We think it very unlikely that it should be so. It would be better than California. It would be impossible to keep it secret. Any blockhead could find it out. Any blockhead could practise it. There is no science, no skill, hardly any exertion. It is very little more than putting 18*s*. into a banker's hand to receive 40*s*. in six months. There would be a guano mania, and a guano king. Perhaps our own experience is a little nearer the mark. In the summer of 1849 we thoroughly drained and fallowed well twenty acres of poor land. In February, 1850, we sowed it with barley, and sowed at the same time 4 cwt. of guano per acre. The cost of the guano when sowed was 45*s*. per acre. We are morally certain, judging from previous experience, that the crop of barley on this land, grown after a year's fallow without manure, would not have been less than three quarters per acre. The actual crop varied only a few bushels in the whole field from five quarters per acre. We cannot state to half a bushel per acre, because we do not know exactly what allowance to make for a few trees which stand in the field. The barley was not of first quality, worth 22*s*. or 23*s*. per quarter. In short, the extra barley just paid for the guano. Still we think that we had an advantage in the transaction. The increased crop kept down annual weeds. We expect to find an advantage, perhaps 5 cwt. of clover-hay per acre, this year. Independent of the pleasure of seeing a good crop on poor land, we should be just willing, on mercantile grounds, to repeat the transaction, and we believe that a similar description would be very applicable to average cases of buying guano and selling produce. When we come to the second means of improving a farmer's position—producing the same quantity at less cost, there is no doubt, no balance; the account is pure gain. Be it much or be it little, he has improved his position by the whole. If it has cost him 4*d*. to thresh a bushel of wheat, and by a new method he threshes it for 2*d*., on a crop of twenty bushels he has improved his position by 3*s*. 4*d*. per acre. If it has cost him 8*s*. per acre to plough his land, and by an improved implement and method he ploughs an acre in the time which three-fourths occupied before, he has improved his position by 2*s*. per acre on every ploughing. If by the removal of fences and trees he adds one productive acre to every ten (*Pusey*, p. 26), he has improved his position by 2*s*. per acre, supposing the rent to be 20*s*. How we are getting on! We should soon put a rent between the farm where these things are well done, and where they are ill done. But we give these merely as the simplest and unexaggerated examples. And let there be no mistake: read Mr. Pusey's pamphlet. Improved and efficient implements do not cost more than the unimproved and inefficient—frequently less.

You need not read anything to tell you that a square field costs less to cultivate than a three-cornered. An owner who will not put his fields into the shape in which they can be cultivated at least cost, does not deserve rent. Increase your produce by increased culture wherever the increased produce will pay for the increased culture. Increase your produce by extra manure whenever the extra produce will pay for the extra manure. But under all circumstances, and in all states of markets, use your utmost endeavours to raise the same amount of produce at diminished cost.

Now a word with the spade-husbandry men; and we shall treat them very curtly, because, among the many humbugs which benevolent individuals have run after, we believe this to be the rankest of all. They found themselves on Jethro Tull, and say that he discovered that culture would supply the place of manure. He discovered nothing but a mare's-nest. The discovery of which they speak would have been the greatest ever made in agriculture, and such discoveries never die. But Tull's no-discovery has been dead these hundred years. Ancient or modern, there is not a single evidence in its favour except his own. But, they say, garden culture and garden produce. See how a gardener digs, and chops, and trenches. Did they ever know a gardener who would cultivate without manure? Ours is ravenous, insatiable; we dread to see him near our manure-heaps. We know something of this matter because we grow potatoes every year by the plough, harrow, and horse-hoe, and others, where we cannot plough, by the spade, rake, and hand-hoe. The former always beat the latter, because the former set of implements are more efficient than the latter. On two-thirds of the cultivated land in England nothing can be less efficient than a spade and rake. They cannot deal with cloddy land at all. Pray do not overwhelm us with instances, because we can prove your case *ad nauseam* by adopting the well-established plan of stating one side. We know two instances, in each of which a benevolent gentleman has devoted a field of the finest old turf to labourers' gardens. The produce has been enormous, the admiration of every one, has gone the round of the papers. It would have been just the same with the plough, but gentlemen vigilantly guard their very fine old turf from the plough. We know several instances in which ordinary land, devoted to labourers' gardens, has diminished year by year in produce, and in which the number of deserted plots has year by year increased. We do not at all deny or doubt that the occupation of a piece of spade-husbandry land is an alleviation to a man who cannot get work; nor do we deny or doubt that an inducement to pick and scrape the roads very often prevents waste. We have seen instances in which a labouring man has been tolerated in taking possession of twenty or thirty perches of a very poor waste, and by picking and scraping has manured it up to a very considerable produce; perhaps, if a value were placed on his own time and on his children's, at considerable cost. But the sight is gratifying: a man has acquired an object endeared to him by honest industry, and has taken a step on the road to independence. When moral good has been created, we do not strictly scrutinize the economical results. But all this is very different from employing spade-husbandry as a remedy for agricultural pressure. Spade-husbandry created the Irish paupers, but it very soon left us to maintain them.

In a work to which we have already alluded, Mr. Johnston, whose general tone and reflections will, we have no doubt, receive the sympathetic approval of a large body of readers, intimates that, recently, in the *Quarterly Review*, we have spoken with unbecoming coolness of the future prospects of agriculture. The coolness must have been of manner; it could not have been of feeling, for it would be difficult to find a person more completely bound up with agriculture, by habit, by taste, and by interest, than ourselves. We might have expressed regrets which would have been sincere, but which would also have been expressed in vain. We did, in the passage to which Mr. Johnston excepts, anticipate for agriculture a revolution to be occasioned by economical pressure; and we still fear that our anticipation was correct, and that the revolution is in progress. All the merely arable farmers, below the first class, whom we see or know, have employed for the last two years less labour, have purchased less manure, and are wearing out their farms and themselves. Our observation, indeed, though not confined to the midland counties, lies principally in them, and there the practice of arable farming is at a very low ebb. Many of the farmers depend mainly on other modes of occupying their land, and every operation connected with crops raised by the plough is performed at much greater cost and in a much more imperfect manner than in the southern or eastern counties. We do not think that on farms where the principal dependence is on dairying, grazing, or sheep-breeding, the pressure is very severe. Grass farms have been less affected than arable, partly because there has been a less percentage of fall in the price of their produce than in cereals, but principally because the cost of production has not hitherto fallen in the same ratio as the price of produce, and on grass farms, as compared with arable, the cost of production is a very immaterial item. Gloomy, however, as is the view which we take of the present state of arable farming, if we are asked whether it will again prosper in England? limiting our ideas to the degree of pecuniary prosperity which is due to a very engaging, a very salubrious, and a tolerably certain employment, we answer without hesitation, that we believe that it will; but not till after a revolution. We feel strongly the pain of a revolution, and we are quite aware, that no business, partly from the habits of those who carry it on, but much more from real natural impediments, from its fixtures we may say, and from its tenures, submits so slowly and so unwillingly to a revolution as agriculture in England. Still the revolution must and will be effected, and those will have the best chance of prosperity who get through it before they are subjected to the full force of domestic as well as of foreign competition. When the revolution is effected, we cannot be blind to the following considerations:—Mr. Pusey says that England has the best climate in the world for farming; and perhaps, if we couple green crops with cereals, this opinion is correct. England affords the best market in the world; has (in our own hemisphere) the most concentrated population, and the best communications; furnishes the best and cheapest implements and machinery. Money is habitually cheaper in England than in any other country. In works of labour and of skill Englishmen challenge the world for efficiency. The existing laws are oppressive to agriculture, but we have a right to expect that justice will prevail, and that agriculture will be relieved. These are surely elements of prospective prosperity. Still, looking to unlimited competition, and bearing strongly in mind how difficult it will be to subject husbandry, which cannot shift the venue, and which must be more or less tied to existing institutions, to the purely-economical regulations which would be adopted in a newly-established manufacture, we would rather express our opinion of prospective arable prosperity negatively than positively.

1st. We believe that no arable farm will prosper which has not, at the least possible outlay of dead capital, buildings which in extent, arrangement, and position, will facilitate the greatest economy of labour.

2nd. That no arable farm will prosper on which, from want of concentration or of good roads, the internal communications are inconvenient and expensive.

3rd. That no arable farm will prosper which is not of sufficient size to employ economically the most efficient implements suited to its texture, the best machinery, and probably steam-power.

4th. That no arable farm will prosper which does not give facilities for the economical production and good management of manure—when such facilities have been discovered;

5th. Which is not dry by nature or thoroughly drained, and entirely emancipated from all sacrifices to taste, fancy, or prejudice.

We assume capital and skill in the occupier. We believe that, under any circumstances which we can anticipate, men of capital and skill will be ready to take farms complying with these conditions, that they will pay an annual sum to cover rent, tithe, and tax, and that on an average of years they will make a competent profit. They will farm higher or lower (but never so as to diminish the fertility of their lands) in conformity with the principles which have been developed in this article.

The conditions here stated are novel in British agriculture, but they are not unreasonable. *Mutatis mutandis*, they would not be considered stringent if applied to any manufacture; indeed, no manufacture could prosper which did not comply with them.

In speaking of the farm of Auchness we made allusion to the advantages which some farmers have derived from paying attention to crops which either do not occur or occur on a more limited scale in the ordinary routine. Probably new objects of culture may be introduced, because pressure is near enough akin to be also the mother of invention. We look forward also to a different appreciation of the present objects of culture. Fine wheat appears to us to be in Great Britain a forced production, and very ungrateful for the sedulous care which we bestow upon it. We select seed with the utmost attention, we create and import varieties, we invent implements expressly for the culture of wheat, we write more on the culture of wheat than on that of any other grain; and when we have done all, the random cultivation of Poland and of *many other countries* leaves us far in the rear in quality. The *Times*, containing a return dated "Corn Exchange, Monday, March 17, 1851," is now before us, and it presents the following results:—The highest price of *any* British wheat is 45*s*. per quarter. The highest price of Dantzic is 48*s*. The highest price of Lincolnshire and Yorkshire wheat is 38*s.*; of Rostock and Wismar, 45*s.*; of Pomeranian, 43*s.*; of Ubermark, 42*s.*; of Silesian, 40*s.*; of Hamburg, Bremen, Holstein, and Lower Rhine, 40*s.*; of Brabant and Louvain, 40*s.*; of Flemish and Zealand, 42*s.*; of French, red, 40*s.*, white, 42*s.*;—a sufficiently discouraging result. And be it remembered that the highest-priced Lincolnshire and Yorkshire wheat is probably fresh threshed, whereas all these foreign wheats have probably been some time in warehouse, and have certainly been subjected to a much longer sea-voyage than the English, and are necessarily more stale and in inferior condition. Flour tells the same tale. Both the French and the Americans deluge us with flour of finer quality than any which can be produced by British millers from British grain. Any one who has seen the white breads of the Continent, of Paris, of Turin, and of Florence, and the macaroni of Naples, must be aware that it would be vain to expect such products from British flour; and when he compares the cultivation of those countries with that of England, he may well be surprised at such results. The fact is that the *quality* of wheat depends much more on climate than on culture. When we look to barley we find exactly opposite results. We quote from the same document. The finest British barley 28*s.* per quarter; the finest Saal, 25*s.*; Danish, 21*s.*; Baltic, small, 18*s.*; Baltic, large, 21*s.*; and the only foreign barleys which are quoted as of malting quality are the Saal and some Danish chevalier. The case of oats is similar to that of barley. The finest British oats, 21*s.* per quarter; the finest foreign, 18*s.* Thus in barley and oats we distance our competitors as much as they distance us in wheat. If you are disposed to experiment in high farming, no grain is so hazardous as wheat. The least extra manuring, or in a moist season even an ordinary manuring, will throw it down. No grain falls so early, is so slow in rising again, or receives so much injury when down. You may bestow manure on barley with much greater confidence of a beneficial result.

If you see a man pass from growing wheat to growing barley, depend upon it he has either improved his culture or his land has been drained or otherwise substantially benefited. All the least and worst arable farmers in England below the hills grow what they call their "bit of wheat," but barley is quite above them. Many of our neighbours on undrained lands tell us that it is of no use to sow barley, explaining, by true farmer's logic, first, that there would be none, and, secondly, that what there was would be fit only for the pigs. But we have exploded that idea. Three of our neighbours, who have thoroughly-drained and highly-manured land of weak staple, not very free, and lying on a retentive bottom, have grown in each of the last three years between 50 and 60 bushels per acre of barley, weighing 55 lbs. per bushel, and of a quality acceptable to the brewers of Burton-on-Trent. This year, for the first time, we have done it ourselves. Thorough draining will make any land barley-land, unless elevation forbids. The case, therefore, stands thus:—Barley is the grain which is most grateful for high farming—barley is the grain, the production of which, *of fine quality*, we have the greatest power to extend—barley is the grain as to which we have least reason to dread the number or the power of our foreign competitors—barley is the grain, the consumption of which is limited by a tax amounting at the present time to cent. per cent.—and barley is the grain which is not allowed to be drunk on the producer's premises for the purpose of reproduction unless he pays the tax. We had almost said, indeed, if the editor does not think that it savours of political intimidation, we shall be obliged to him if he will allow us to say, that we will never vote for a county member who does not vote for the repeal of the Malt Tax.

Many persons have expressed an apprehension that the owners of landed property in Great Britain are in danger of being permanently degraded. We do not believe that this can be the case in a country constantly increasing in population and wealth, which is constantly consuming land by buildings, pleasure-grounds, roads, railways, docks, and cemeteries, and in which the possession of land is a pride and a passion. Nor do we believe that the revenue derived from real property can be permanently diminished. The British landowner never felt himself to be a rich man, as compared to a person deriving an equal income from other sources, because, whatever might be his personal frugality, he has always been subject to the temptation of expending his savings on his property, and it has been quite as often on blunders and fancies as on improvements which added to his revenue. It may be that for a period, now commenced or at hand, he may have to season the pride of his position with somewhat of increased pressure, because he is always in debt. He has been the shuttlecock of those legislatures who have sported with the currency; struck up to a giddy height from 1797 to 1815, from which height he has been let down by successive subsidences to his present depressed condition. Mr. Johnston, in "England as it is," reckons the "indebtedness" of real property in England at one-half of its absolute value, and the annual charge of such indebtedness at one-half of its revenue. But for the circumstance that this debt, both as to principal and interest, is a "*fixed amount of money*," the statement would amount to no more than this—that the apparent owners of the real property in question only own one-half of it, and that somebody else owns the other half. "But," as Mr. Johnston justly observes, "when we take into account debts or fixed engagements of any kind, a change in the currency must disturb the balance of justice; and when the change is such as to increase the value of money, it is a severe measure of oppression upon the weaker and indebted class, while an undue advantage is given to those who are least in need of it." Under this oppression the present race of landowners are struggling; and, on the whole, manfully. A certain amount of change in the ownership of land is always in progress, and is no doubt salutary to the body politic; but the tenacity of landowners has, under all difficulties, opposed a successful resistance to a sweeping revolution. Any one who looks into Fuller's Worthies, or Sir William Dugdale's Catalogues of Commissioners, or into the indexes attached to Plott's and other county histories, will find the old names attached to the old places to a considerable extent. Our hope and belief is, that, notwithstanding present difficulties, the hereditary owners of land will, by a continued exertion of the energy and prudence which carried those from whom they inherit their possessions through all changes, continue to maintain their social position.

The reproach of British agriculture, that she had no literature, is fast passing away. The works which we have placed at the head of this article would be creditable to any science and to any age. We are not acquainted with the agricultural publications north of Tweed, but we have been told that they have great merit. We constantly see with wonder and admiration the variety and spirit by which the Royal Agricultural Journal is sustained. The Agricultural Gazette, attached to the Gardener's Chronicle, contains almost weekly some practical article of sterling value. The letters of the *Times*' Commissioner have ably supplied a deficiency which has existed ever since the time of Arthur Young's agricultural tour. They have informed the general body of agriculturists of the varieties of practice which have obtained a permanent footing in various districts, causing each to contribute its quota of knowledge and experience to the general stock of information. In offering our own humble mite we are indeed proud of our fellow-labourers.

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THREE LECTURES

ON

AGRICULTURE;

DELIVERED AT OXFORD,

ON JULY 22ND, AND NOV. 25TH, 1840; AND ON JAN. 26TH, 1841,

IN WHICH THE CHEMICAL OPERATION OF MANURES IS PARTICULARLY CONSIDERED, AND THE SCIENTIFIC PRINCIPLES EXPLAINED, UPON WHICH THEIR EFFICACY APPEARS TO DEPEND.

BY

CHARLES DAUBENY, M.D., F.R.S., M.R.I.A., &c.

SIBTHORPIAN PROFESSOR OF RURAL ECONOMY IN THE UNIVERSITY OF OXFORD.

> Nam qui se in hac scientia perfectum volet profiteri, sit oportet rerum naturæ sagacissimus; declinationum mundi non ignarus, &c.——
> Quæ prænoscere sine lumine animi, et sine exquisitissimis disciplinis, non quemquam posse crediderim.—COLUMELLA, lib. I.

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M.DCCC.XLI.

TO

HIS GRACE

THE DUKE OF RICHMOND,

K. G.

LATE PRESIDENT OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND,

&c. &c.

THESE LECTURES

ARE BY PERMISSION INSCRIBED

BY HIS HUMBLE AND OBEDIENT SERVANT,

THE AUTHOR.

PREFACE.

In the autumn of last year I was honoured by the Council of the British Association for the Advancement of Science, with a request, to prepare a Report on the "Connexion between Chemistry and Agriculture."

Independently of the disposition I should at all times feel to comply with the wishes of a Body with which I have been connected from the first year of its institution, I was in the present instance the more ready to undertake such an office, from having for some time previously had my attention directed to the subject of Agricultural Chemistry, in consequence of being appointed to deliver lectures on Rural Economy in the University of Oxford.

But about the same time at which this official communication was made to me, I was put in possession of a work by Professor Liebig, of Giessen, entitled "Organic Chemistry in its applications to Agriculture and Physiology," drawn up, as the learned author expressly states, as a portion of the Report on Organic Chemistry, which he had been solicited to prepare for the British Association, at the suggestion of the Chemical Section.

Now I am persuaded, that it was only through ignorance of the intended nature of Professor Liebig's Report, which indeed its title, Organic Chemistry, was not likely by itself to suggest, that the Association had been induced to apply to another of its members for further information on this subject; and for my own part, on rising from the perusal of the volume in question, my mind was fully made up as to the propriety of declining the honourable task confided to me, not only out of delicacy to its distinguished author, but likewise from the estimate I had formed of the work itself, which appeared to me, to have in a great degree fulfilled the object which the Association had in view in requiring such a Report, and at the same time, to have shed such important light upon the general principles of Agricultural Chemistry, that it might well be considered an act of presumption on my part, to place my humble labours in juxta-position with researches of so high and so original a character.

These considerations, however, need not deter me from laying before the public, through a distinct channel, the Lectures which I have delivered before the University, since my appointment to the Professorship of Rural Economy.

In these Lectures, although I freely own myself indebted for the fundamental doctrines that have been laid down, as well as for many of the details that have been dwelt upon, to the work of Professor Liebig, yet it is fair both to him and to myself to state, that I have interwoven much matter, that is either my own, or drawn from other sources than those of his work; that I have often attempted to deduce from his principles consequences, for which he is nowise answerable; and that I have endeavoured to remove any impediments that may exist amongst agriculturists to the reception of the novel views propounded in his Report, by giving to my exposition of them as much as possible of an English character, both as to style and arrangement, and by disencumbering it of all such references to recondite chemical truths, as did not seem essential to the establishment of the leading propositions.

For the remarks introduced at the conclusion of my third Lecture, in which I have attempted to connect the supply of certain of the elementary principles of organic matter with the operations of volcanos, I must confess myself wholly responsible; although the principle upon which I have proceeded, namely, that nitrogen gas is never found on the surface of the globe to enter into combination with hydrogen, but must in the first instance be deprived of its elastic condition, in order that it may exert an affinity for this body, is suggested by Professor Liebig himself.

Notwithstanding, therefore, that the Professor nowhere derives the ammonia which supplies plants with their nitrogen from volcanic operations, the conclusion to which he has arrived, "*that it has not been produced by the animal organism, but existed before the creation of human beings, being a part, a primary constituent, of the globe itself*," affords to my mind an equally valuable confirmation of the views to which I had been led by my previous researches; and, if any apology be required for appending such speculations to a course of Lectures on Agriculture, it may be supplied, by referring to the attack which has just been made upon the theory alluded to by the learned Professor of Chemistry at Bonn[a], from whose sharp fire I am glad for the present to shelter myself, by interposing, as a shield, the authority of his distinguished countryman at Giessen, whose weight on questions of science, he will, I am sure, be the first to acknowledge.

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[a] See Professor Bischof's Reasons against the Chemical Theory of Volcanos, in Jameson's Journal, No. for Jan. 1841.

Without, however, building too much upon illustrious names, I would merely ask my chemical brethren, whether they can produce me an instance, in which nitrogen gas is unequivocally shewn to have combined with any compound body whatsoever, or with any elementary one, excepting oxygen[b], without having been previously in a state of combination; whether that *chemical indifference*, or in other words, that obstinacy in maintaining, and readiness in reverting to, an elastic form, which peculiarly characterizes this body, may not have its express uses with reference to the animal and vegetable organization into which it enters as a constituent; and whether, if these facts be admitted, it does not seem to them probable, that the observed extrication of ammonia from the bowels of the earth may be intended for some specific purpose in the economy of nature?

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[b] Cavendish has shewn, that nitrogen may be made to combine with oxygen gas by electricity, but it seems probable, that the nitric acid produced in nature, results ordinarily from the previous decomposition of animal and vegetable matter.

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RURAL ECONOMY.

LECTURE I.

MR. VICE-CHANCELLOR AND GENTLEMEN,

ON addressing you for the first time in the capacity of Professor of Rural Economy in this University, it behoves me perhaps to preface my remarks with some mention of the circumstances which have led to my appointment to this new office.

Most of you, indeed, may be aware, that the Chair in question owes its origin to the late Dr. John Sibthorp, who bequeathed to us an estate in trust for the purpose of endowing it; but you may not be so well informed as to the circumstances that have so long retarded the execution of the munificent intentions of its founder.

Anxious to perpetuate the memory and fruits of those labours, which his zeal for natural history had prompted him to undertake, Professor Sibthorp employed, during the latter years of his life, that eminent artist Mr. Ferdinand Bauer, to execute drawings of nearly a thousand of the most interesting plants, that he had at different times collected during his travels in the Levant [a].

---

[a] Mr. Bauer also made for Dr. Sibthorp a series of admirable coloured drawings of the quadrupeds, birds, reptiles, and fishes of the Levant, which are preserved in the library belonging to the Oxford Botanical Garden, but have never yet been engraved.

To the editing of these, in a style which should not detract from the beauty of the original drawings, or weaken their authority as representations of the vegetable productions of the classical lands which were the scene of his researches, he directed that the entire proceeds of the endowment in question should in the first instance be devoted; and those who are able to appreciate the elaborate fidelity of the engravings which illustrate the Flora Græca, and who know how small a portion of their expense has been defrayed by the public, whilst they regret that the circulation of this unrivalled botanical work should have been so limited, will cease to be surprised at the large demands made from time to time on the estate for its completion, or that for more than forty years from the death of the testator the execution of his ulterior designs should have been suspended in consequence.

Slowly indeed as the publication has appeared to advance, and long as the establishment of the Professorship of Rural Economy has in consequence been delayed, I have reason nevertheless to congratulate myself on one piece of good fortune connected with it, which no one at the commencement would have had any right to anticipate, namely, that at this distance of time from the death of the testator, two out of three of the executors, under his will, of this and his other bequests, both of whom were his cotemporaries, the one being his school-fellow, and the other his fellow-traveller in Greece, should still continue in the possession of life and activity.

One of these gentlemen, who has been charged with the chief management of the work, retains in his eighty-second year that energy of mind and body, which has at length enabled him, in spite of all obstacles, to carry through so arduous an undertaking; and I feel that it is in a great degree to the business-like habits and steady perseverance of this individual, seconded as they have been by the exertions of the distinguished botanist to whom the task of editing the later volumes has been intrusted, that I am indebted, for being even now invested with the appointment which brings me before you on this occasion.

But before I enter upon the subject more immediately under consideration, it may be well to say a few words in explanation of the views which may be supposed to have guided Dr. Sibthorp in directing, as he has done, that the Sherardian Professor of Botany for the time being should be chosen to fill this new office of his creation, except in cases where the individual who occupied that Chair was engrossed by the cares and engagements of medical practice.

And this vindication appears the more necessary on an occasion, when, in compliance with these instructions of the founder, the endowment in question has devolved to one, who, however alive to the importance of the subject, and to its bearings in various branches of science, cannot certainly boast of having at any period of his life devoted much of his attention to the practical details of husbandry.

In making this selection, Dr. Sibthorp, I am persuaded, was not actuated by a disposition to underrate the importance of practical experience, or by entertaining the erroneous notion, that any amount of scientific knowledge could stand in stead of that tact and skill, which long attention to the management of a farm alone can impart.

One may with reason be sceptical as to the truth of what is related of Lavoisier, who, though inexperienced in agriculture, is said to have doubled the produce of an estate which he once undertook to cultivate, by the resources of his chemical skill; and it might hardly be deemed prudent to resign oneself implicitly even to the guidance of a Davy in the details of rural economy, highly as one might estimate the merits of his work on Agricultural Chemistry.

But it must be recollected, that the very same remark would be equally applicable to all the processes of the manufacturer—to every one of those complicated operations, on which so many of the comforts and conveniences of our existence are dependent.

No master manufacturer, I conceive, would choose to put himself under the direction of an unpractised individual, even though he gave him credit for the penetrating genius of a Black, or the inventive skill of a Watt, and yet without the improvements, which the principles laid down by the one suggested, and which the mechanical ingenuity of the other matured and perfected, the distaff might still continue to do the work of the spinning jenny; and our ships have to depend upon the precarious assistance of the winds, instead of being propelled by the giant force of the steam-engine.

In the manufactures indeed, no one now for a moment thinks of questioning the value of science in suggesting improvements which are afterwards to be tested by experience; no one grudges the expenditure of time and labour which must be undergone, for the mere chance of effecting the smallest saving in the production of any article of consumption, however limited may be its use, or subordinate its importance.

No one questions, that the chemist is profitably employed in attempting, to facilitate any method by which a compound employed in the arts is generated, or to convert to an useful purpose materials hitherto thrown aside as refuse; nor does the most experienced manufacturer undervalue an appeal to principles of science on the part of those who propose to him any modification in the existing processes. And yet how small is the range within which the possible services of the experimentalist are circumscribed, where he succeeds in improving or facilitating the production of any manufactured article of consumption, compared to that of the utility which would attend the slightest amelioration which he might effect, in the general productiveness of the soil, or even in the mechanical or other methods for abridging the labours of the husbandman.

In an excellent paper attributed to Mr. Philip Pusey, which forms the introduction to the Journal of the English Agricultural Society, the immense national advantages accruing from the slightest improvement in agricultural skill are put forwards in a very clear and striking light.

"The wheat produced in England and Wales," he remarks, "is estimated by Mr. Mac Culloch, one year with another, at 12,350,000 quarters.

"This single head of produce, therefore, at an average price of fifty shillings, will amount to nearly 31,000,000*l.* sterling yearly. The oats and beans have been reckoned at 13,500,000 quarters, and will give another head of 17,500,000*l.* sterling per annum.

"The grass-lands, again, are supposed to yield, year by year, produce worth very nearly 60,000,000*l.* sterling.

"The practical inference to be drawn from these large numbers is obviously this: That, if by any improved process it be possible to add even in a small proportion to the average acreable produce, either of arable or pasture land, this increase, small as it may seem, may in fact be a very large addition to our national wealth.

"The average produce of wheat, for instance, is stated at twenty-six bushels per acre; if by a better selection of seed we could raise this amount to twenty-seven bushels only (a supposition by no means unlikely), we should by this apparently small improvement have added to the nation's annual income 475,000 quarters of wheat, worth, at fifty shillings, about 1,200,000*l.* yearly, which would be equal to a capital of 24,000,000*l.* sterling gained for ever to the country by this trifling increase in the growth of one article alone, and that in England and Wales only."

But it is to be feared, that there does not prevail amongst the agricultural population that same disposition to discover new methods, and to improve upon old ones, which characterizes our manufacturers.

It is true indeed, that the increasing intelligence of the people, the command of capital that can be here made available, the superior energy of character which belongs to the British race, and above all that greater confidence in remote returns for large immediate outlays, which has grown up in consequence of the long immunity which a kind Providence has vouchsafed to this nation from foreign as well as from domestic wars, are circumstances which have given us advantages over our neighbours even in the cultivation of the soil, by which we have largely profited.

Yet in spite of this, it may be sufficient to advert to the higher price of corn at home than abroad, in order to shew, that we do not possess such an ascendancy over other nations in our agricultural, as we have long maintained in our manufacturing skill. And if the cause of this difference be inquired into, we shall probably find reason to attribute it, to the disinclination of farmers in general to deviate from their accustomed routine, their prejudice against new-fangled contrivances, and the difficulties that are met with in persuading them even to avail themselves of improvements, the advantage of which has been demonstrated.

Thus Mr. Pusey, in the article already referred to, instances the limited use made of the machine for slicing turnips, as a proof of the greater slowness of the agricultural portion of the population to adopt new systems.

"If a contrivance," he says, "were discovered in Manchester which would save one-fifth of the cotton consumed in a manufacture, (were such a saving possible,) not a year would pass before most of the old machinery would be replaced by the new; but the turnip is the raw material of the farmer's stock, and the farmer is of the same enterprising race with the manufacturer; why then, but on account of the separate and secluded scene of his industry, is the spread of agricultural inventions so slow—the extension of those which concern the manufacturers so rapid: and what but a central connection of the cultivators of the soil can diminish the distance and remove the obstruction?"

It was indeed in great measure the growing sense entertained of this defect in the character of our rural population, and of the proper means of correcting it, that led to the convening of that great body of agriculturists, which, in imitation of the example set them by the men of science in this country, proposes to assemble once in every year at some one of our provincial cities.

And I cannot but conceive that it will hereafter be regarded as a proud distinction to Oxford, to have been the first to welcome the English Agricultural Society, no less than that which may be considered in some sense its parent,—I mean the British Association for the Advancement of Science.

The former, it will long be recollected by us with pride and satisfaction, held its first session within our precincts; whilst the latter may perhaps be justly considered as dating its commencement from the time of its assembling here, since the meeting previously convened at York appeared, from the comparatively small scale on which it was conducted, to be rather an experiment as to whether such a scheme were feasible, than an actual attempt to carry out its objects.

In both the Associations alluded to, the leading object seems to have been to bring about an increased intercourse between the men of *theory* and the men of *practice*, and thus to correct at once the crudities of the former, and the stationary habits of the latter description of persons.

And it was perhaps in anticipation of this great movement, or at least in full participation in the spirit which has produced it, that the founder of the Professorship of Rural Economy directed, that this new office should be attached to the Chair of Botany, which he had himself filled with so much reputation.

Not that his own experience led him to expect, that the individual who held the latter office would be in general conversant in the details of husbandry, but that, if he only possessed a competent knowledge of botany and other kindred sciences, he might be enabled at times to throw light upon the operations of agriculture, and suggest improvements, of which the practical farmer might take advantage.

Nor will it, I hope, be considered, that I am the less competent to discharge these duties, because I have the honour also to fill, in this University, the office of Professor of Chemistry; seeing, that whilst it is the province of the Botanist to study the nature of the plants which afford nutriment to man and animals, it is no less that of the Chemist, to detect those differences in the constitution of the soil, and of the substances superadded to it as manures, on a knowledge of which the successful cultivation of these plants especially depends.

Such then being my view of the duties imposed upon me by my new Appointment, I cannot perhaps do better, than to occupy the remainder of the time allotted to this discourse, in presenting to you a sketch of a few points connected with the subject of Rural Economy, on which the kindred sciences of botany and chemistry may be expected to throw light, and thus to communicate to you, incidentally, certain hints, as to the nature of those inquiries, which will from time to time be brought before you in the course of my succeeding lectures.

As to the instruction, indeed, which the agriculturist may derive from a scientific acquaintance with botany and vegetable physiology, when conjoined with practical experience, it will not be necessary for me to dilate. It must be obvious, that although to proceed in one unvarying routine of practice might require only a knowledge of the plants actually cultivated, and of the weeds which accompany them, yet that to improve upon existing methods, or to adapt received ones to an altered condition of circumstances, demands some insight into the general structure and functions of vegetables, and into the relations of their members one to the other.

Thus, for example, the principles on which we proceed in protecting plants from the influence of frost, are derived from the knowledge possessed with respect to the circulation of the sap, and consequently as to the means of suspending it.

Proceeding upon these data, the gardeners at Nice and Genoa, whenever a severe frost sets in, pluck off the leaves of their orange-trees, by which means the sap ceases to rise, and the injury which would be done to the trunk by the freezing of its aqueous juices is thereby prevented.

Thus the very system of arranging the succession of crops, presupposes some acquaintance with the relations of the plants themselves, and in introducing any fresh member into the cycle, its place in the series should be determined by considering the natural family to which it belongs.

Nay, even in the common operation of trenching, the damages occasionally done to the contiguous timber would have been prevented, if the husbandman had been always aware, of the dependance of trees upon the extreme points of their roots, and of the great distance to which the latter extend.

The fit period for collecting the fruits of the soil depends upon the physiological fact, that the farinaceous matter which constitutes the nutritive portion of those tubers, that serve for food to man, being designed for the nourishment of the bud, begins to be consumed so soon as the latter starts into existence.

Hence the propriety of approximating as nearly as possible to the point of time at which the whole magazine of nourishment is accumulated, and none of it has as yet begun to be expended.

An interesting method of making use of frozen potatoes, and even of applying frost as a means of preserving them for an indefinite time, has been suggested by a more intimate knowledge, derived from microscopical investigation, with respect to the minute structure of the parts in which the fecula resides, than we had previously possessed.

It appears, that the acrid matter contained in the rind of the potatoe, in common with all the members of the nightshade family, is not mixed with the other fluids of the cells of the tuber, so long as the latter is in a sound condition ; but that when frost has separated these cells one from the other, the fluid then extravasated flows into these interstices, and the acrid and venomous matter dissolved by them partakes of the general diffusion. Hence, the starch becomes unwholesome and unpalatable, and is rejected both by man and brutes.

Now it has been found, that the starch which we convert into nourishment is contained chiefly in the cortical layers of the tuber, and the acrid matter in the epidermis, so that in a sound state of the tuber the two do not intermix, and if we can only prevent this from happening to the potatoe after it has been frozen, we shall obtain it in as wholesome a condition as before. Now this is effected by drying the potatoes as quickly as possible after they have been thawed, a practice indeed which had been adopted from an early period by the Peruvians, and which enables them to take advantage of a superabundant crop, by freezing the overplus, to destroy their vitality, and afterwards rapidly drying them, so as to preserve them for an indefinite time.

It has also been found, that the reason why frozen potatoes supply very little starch, is not that this principle is destroyed, but that owing to the cells which contain it, being detached one from the other by the act of freezing, the process of rasping, by which the starch is usually separated, does not tear them open so as to dislodge their contents.

If however it be thought, that the cultivation of plants, although explicable of course on physiological principles, having nevertheless been derived from experience and observation, may be pursued successfully without the lights of modern science; it must at least be admitted, that the same conclusion cannot be extended to those circumstances by which their growth is affected, whether derivable from the nature of the soil itself, the adventitious matters superadded to it, which we denominate manures, or those influences of a still more subtle description, that come under the general denomination of climate.

Here we have a wide field open to us, in which the aid of chemical knowledge is most important, and where it will be difficult for the farmer even to keep his footing, and still more to extend his conquests over nature, if he neglects to avail himself of those arms, and that improved system of warfare, which science places within his reach.

I will therefore conclude this Lecture, by briefly pointing out a few of the prominent subjects of investigation, which fall under the jurisdiction of the agricultural chemist.

And first, a wide question presents itself, which can only be determined by a long series of researches, and which, though apparently of a speculative character, has many important bearings upon practice. Whence do organic bodies obtain the principles which enter into their composition, and become assimilated to their living organization?

With regard to the animal kingdom, indeed, the answer to this inquiry is more easy. It seems to be generally admitted, that no substance can enter as a constituent into any animal fabric, which has not previously made a part of some organic matter.

Boussingault has also shewn, by a very careful series of experiments, that even the azote which animal matters contain is probably derived from vegetables, for in the case of the horse and ox, he found that the proportion of azote present in their excrement, was considerably less than that existing in the food which they had taken in[b].

Animals, therefore, it would appear, derive their support, directly or indirectly, from vegetables, carnivorous species feeding on herbivorous ones, herbivorous ones being supported by vegetable matter alone.

But with regard to the latter, the problem becomes a more difficult one;—it involves, indeed, a question of a higher order, with respect to the origin of created things in general, namely, whether the same amount of animal and vegetable matter as at present has existed from the first, or whether any means have been provided, by which an addition can from time to time be made to their respective quantities.

A question so speculative as this may hardly seem to come within the scope of agricultural inquiries, but, waving, at least for the present, its discussion, I will here remark, that whatever uncertainty may exist with regard to the origin of the vegetable creation, it is a matter of the first importance to ascertain, whether plants can derive from the air all or any of the principles which enter into their composition, since upon this will depend our decision, as to the degree in which animal manures are requisite, how far mineral ones admit of being substituted, and to what particular kinds of plants they are most applicable.

Here then it is evident that the aid of chemistry is indispensable, whether it be our object to determine, the constitution of the plants themselves, that of the soil in which they grow, that of the substances which are superadded to the latter as manure, or lastly, that of the foreign matters, subservient to vegetation, which may be diffused through the atmosphere.

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[b] Annales de Chimie, June, 1839.

The full consideration of so wide a subject must, however, be reserved for future opportunities.

Nor in speaking of manures, must I omit the important advantage likely to result from the chemical discovery, that night-soil may be rendered both inoffensive and portable, by admixture with animal charcoal obtained from the refuse of the sugar refineries.

When we recollect with what avidity the smallest quantity of manure is collected in countries where it is scarce, it seems hardly possible to calculate the enormous annual loss hitherto sustained by this country, owing to the excrementitious matters derived from a vast metropolis like London, being all deposited uselessly in the bed of the Thames.

Owing to this waste, it is a curious fact, that cattle are slaughtered in South America, often for no other purpose, than that their bones ground into dust should be sent over to manure the turnip-fields of England, so that our commerce has been hitherto compelled to supply from a great distance a material, which an application of chemical skill at home now promises to secure to us.

Another branch of inquiry, wholly chemical, relates to the composition of the soil found best adapted for peculiar crops, and under this head I would include, not merely a knowledge of its constituent parts, but also of its relation to moisture, heat, &c.

One interesting point, which does not appear to be sufficiently investigated, but on which I have myself made a few experiments, relates to the power which different soils possess of absorbing certain gases [c].

I have no doubt, that their fertility mainly depends upon this circumstance, for it is evident, that when these gases are brought into contact with the plant in a condensed state within the pores of the soil, they will be absorbed in greater quantity, than when presented to it in the rarefied condition, in which they exist in the atmosphere.

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[c] For further remarks on this subject see the following Lecture.

Another important line of research, by which the chemist may afford essential service to the agriculturist, relates to the operation of manures.

These are in general distinguished into organic and inorganic, the former consisting of the excrements of various animals, or of organic substances in a state of decomposition—the latter, of the various saline and earthy matters, which may be mixed with the soil.

The former description of manure has been already noticed—its action is doubtless that of imparting directly to the vegetable those principles which enter into its composition, such as azote, carbon, &c.; and likewise perhaps that of stimulating its organs to a more vigorous discharge of their respective functions, thus enabling it to extract a more abundant supply of nourishment from other sources likewise.

But the action of mineral manures is more complicated and less perfectly understood, and hence, in applying them, we are often guilty of the fatal error of administering that, which has been found a valuable medicine for one description of plants, to a crop of totally different habits.

In what manner, for example, does saltpetre, or that valuable substitute for it lately introduced, nitrate of soda, operate upon the plant, which is so effectually benefited by the application.

Do these salts act merely as stimuli, or do they also communicate to the vegetable any of those principles which enter into its component parts?

If the latter be the true solution, does the nitre itself become assimilated, or is the nitric acid which it contains decomposed, so as to furnish the nitrogen required by the plant?

The determination of these questions would suggest to us means for discriminating, both the quantity of nitre which should be applied in each instance as a manure, and likewise the description of plants to which it is likely to be advantageous, and hence, amongst the chemical researches by which agriculture is likely to be benefited, may be numbered that of ascertaining, by an accurate analysis of the soil, both before and after the crop is sown, whether the amount of the nitric salt added has undergone any diminution during the intervening period.

A third branch of inquiry relates to the cause of that failure, which is noted as taking place in a crop when it has been introduced a second year into the same soil, or when it has succeeded another of the same natural family—a research, upon which depends the whole doctrine of the rotation of crops, which has already worked so important an improvement in the art of husbandry, wherever it has been adopted in practice.

It has been argued, that the failure alluded to cannot altogether arise from the exhaustion of the soil, for in that case no other plant would be sown after it with advantage, but its explanation must in part be sought for, either on the principle that each crop requires some particular *pabulum*, of which the soil may contain only a definite amount, or by assuming, that every species of vegetable imparts to the soil something, which to its own species is noxious, but to others may be nutritious.

The former is the old and still the more generally received theory: the latter is one which has been recommended by the weighty authority of the great Genevese botanist, Mons. Decandolle.

According to the latter author, the extremities of the roots in all plants not only absorb nourishment from the ground, but likewise at the same time impart to it in return something derived from its own substance.

It has been observed for instance, that if we place a plant in sand moistened with distilled water, the roots disengage, during the night, little drops of some fluid, which after a time concrete into a solid form.

Now this fluid is considered by Decandolle to hold the same relation to the vegetable, which the excrement bears to the animal, and, as the latter constitutes the food of other tribes, so the former affords nutriment to certain plants, whilst it is injurious to others, and more especially so to those of the same species from which it had itself been derived.

This is the reason, why some plants thrive, and others languish in each other's vicinity; it explains, why the cirsium arvense, for instance, is injurious to the oat, whilst the presence of certain species of orobanche seems to favour the growth of flax, and also thrives itself most in the midst of this kind of crop.

That these supposed exudations are uniformly more or less injurious to plants of similar species, has been inferred, from the acknowledged fact, that a soil, in which peach or apple-trees have grown, is unfit for young shoots of the same description, so as to render it a necessary rule in practice, that a piece of ground should be occupied by forest and by fruit-trees alternately.

Reference has also been made to a circumstance, which most travellers in the United States have remarked, and which I myself, during my tour in that country, had frequent opportunities of substantiating, namely, that where a forest of oak or of maple has been destroyed, the trees, that are apt to shoot up spontaneously in their place, are of the fir-tribe; whereas, if a pine-forest be cut down, young oaks and other allied species will make their appearance afterwards.

This same conclusion has also been supported by some experiments, which, at the suggestion of Decandolle, were instituted at Geneva, by Mons. Macaire-Prinsep.

Thus, fresh roots of the chondrilla muralis, being each day introduced into a portion of distilled water, imparted to the latter, at the expiration of a week, an odour resembling that of opium, together with a bitter taste; and even the roots of the kidney-bean, when placed in a vessel of water, communicated to it indications of the presence of an excreted matter, of which a larger amount was afforded during the night than the day.

Macaire also found, that when poisonous substances, such as sugar of lead, had been absorbed by one parcel of the roots, they would be at the same time excreted by another.

Nevertheless, in spite of these apparently direct experiments, opposite results have been obtained by others, as for instance by Mons. Braconnot[d], who states, that in many instances he could discover no signs of any such exudations, and that in others, as in the case of the common lettuce, where he did detect them, their presence ought to be attributed to a laceration of the fibres of the roots, and a consequent extravasation of the fluid they contain.

This he supposes to have happened in the experiments of Mons. Macaire, and he further remarks, that the poppy (*Papaver somniferum*) has been planted ten years successively at Nancy, without any failure of the crop accruing, nor did he afterwards find in the soil sufficient of any matter, which could be traced to the plant, to justify the inference, that it had continued throughout that long period, exuding matter from its roots.

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[d] Annales de Chemie, 1839.

He also accounts for the transmission of the sugar of lead from one parcel of roots to another by capillary attraction, and maintains accordingly, that it may be prevented by surrounding the stem externally with bibulous paper.

Amidst these conflicting authorities, I trust the series of experiments, which I have been for some time past carrying on in the Botanic Garden, may not be considered as altogether superfluous.

The object I have had in view in undertaking them, was to ascertain—in the first place, how many successive years the soil may admit of the growth of the same crop, and, if it becomes deteriorated, at what rate the decrease of produce may proceed; and in the second place, what kind of vegetables will afterwards thrive best in soil, which, with reference to this particular crop, has become damaged, or effete.

With a view to determine this, I have set apart, in one portion of our Botanical Garden, a number of distinct plots of ground, of known size, and uniform as to quality.

These were in the first instance enriched with an equal amount of manure, and brought, as nearly as could be done, in every respect into a similar condition.

Fifteen of these beds are planted year after year, without intermission, with the following crops: viz. potatoes, turnips, barley, oats, poppies (*Papaver somniferum*), buck-wheat, tobacco (*Nicotiana rustica*), flax, hemp, endive, clover (*Trifolium pratense*), mint (*Mentha viridis*), beans, parsley, and beet.

The remaining fifteen beds receive in turn the same crops, but each year a different one is introduced; so that by comparing the amount of produce obtained each year from the first and second class of beds—those in which the crop is permanent, and those in which it is made to shift about—we may be enabled to learn, how much of any actual diminution ought to be attributed to the season, and how much to a deterioration or exhaustion of the soil.

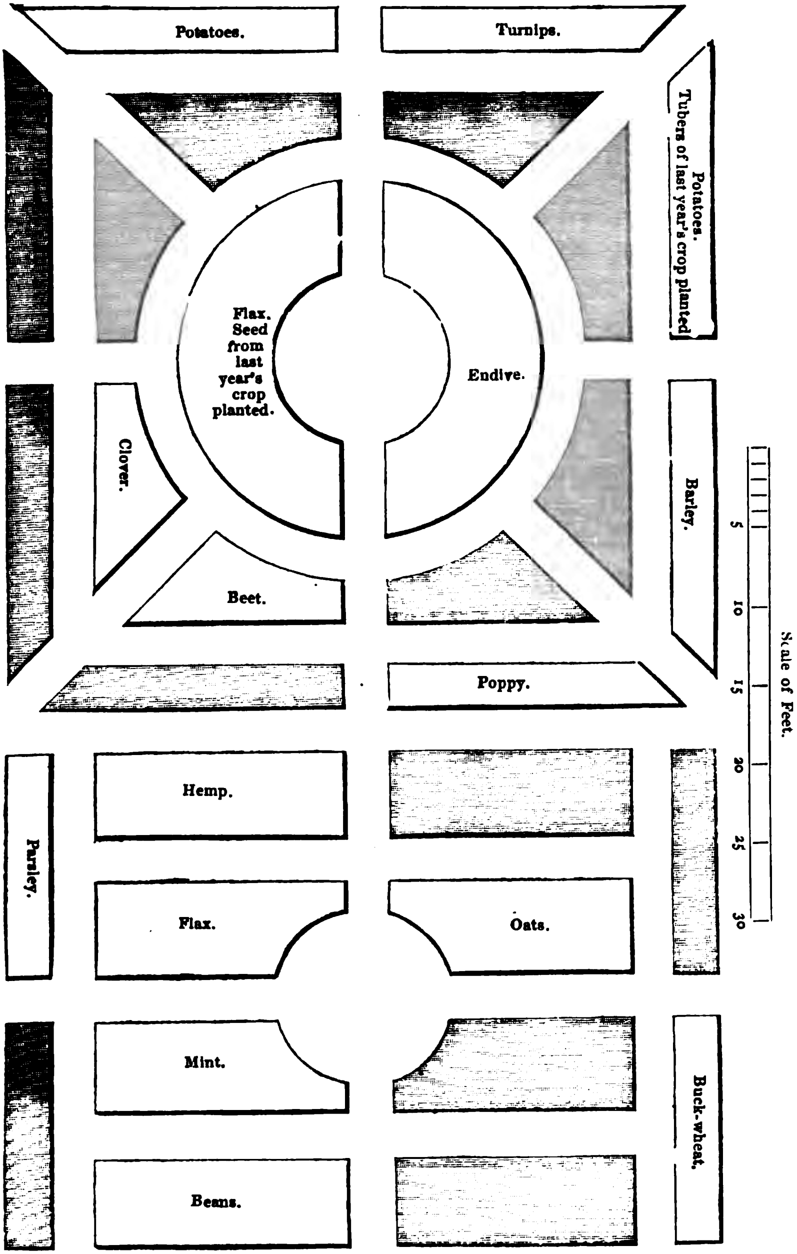
As it is scarcely five years since the experiments were commenced, the progress made has not yet been sufficient to render the results worth quoting; but should life and leisure be allowed me for bringing them to a conclusion, I trust some inferences may hereafter be deduced of utility to future husbandmen; although I should be far more sanguine with respect to the benefit that would accrue, if a piece of ground of greater extent were set apart for such experiments, as, under the auspices of any of our great Agricultural Societies, it might not be difficult to effect.

Should Science, indeed, succeed in settling, the true cause of the deterioration of crops, and the most advantageous order of their succession, it is unnecessary for me to point out how important a boon she would confer upon the agriculturist.

So extremely various indeed are the systems upon which the rotation is carried on in different countries, that no fixed principle would appear to regulate them, and the whole may be considered, as being founded much more upon the authority of long usage and tradition, than upon any actual comparison of the relative advantages of those resorted to in various places.

This inquiry may therefore be pointed out, as being one of those lines of investigation, in prosecuting which the scientific chemist may be expected to benefit the practical farmer.

PLAN OF EXPERIMENTAL GARDEN.



N.B. In the unshaded beds, it is intended that the crop, the name of which is annexed, shall be repeated, until the ground appears exhausted, whilst in the shaded beds, a different crop is introduced each year.

And there are many other such lines of research — for, indeed, the relations of climate to vegetation, including under the former term the subtle influences of light and electricity, of which we are hardly yet fully cognisant, but which operate powerfully in many ways upon the vegetable, as they do upon the animal kingdom, require for their elucidation the assistance both of the chemist and of the natural philosopher.

I have shewn, in my experiments respecting the Influence of light upon plants[f], that, up to a certain point, and with reference to certain functions of the vegetable economy, the stimulus of *heat* admits of being substituted for that of *light*, and it has recently been suggested, that the want of solar influence upon tropical plants, during the winter months, might possibly be supplied by artificial illumination.

It is evident, indeed, that different kinds of plants are differently affected by the stimulus of light, since in the gloomy forests of the tropics, the leaves of epiphytal Orchideæ discharge the same functions, as those of the loftier trees which are exposed to the full blaze of the sun.

Such circumstances require to be taken into the account, in considering the practical subject of climatization.

On the other hand, the difficulty of successfully cultivating certain plants seems at present imperfectly understood.

Is it the fact, for example, that the vine cannot find a climate exactly suited to it, throughout the wide range of latitude included by the United States? or does its failure arise merely from the attention of the husbandman having been hitherto directed to more essential, or more profitable kinds of culture?

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[f] Philosophical Transactions, 1836.

If the former be the true solution, what are the circumstances in the condition of the atmosphere, which render the climate of North America unfit for its production?

Again, how far does the limitation of particular species within a certain geographical range, depend upon their peculiar adaptation to the climate, and in what degree may we account for it, by the theory of certain *foci* of vegetation?

These are practical subjects, upon which I shall have occasion to enter more fully in my succeeding Lectures.

In the present, enough, I trust, has already been said to convince you, that even without much practical acquaintance with the details of agriculture, it may be possible for me to offer from time to time to my audience certain hints on the subject of Rural Economy, which, if taken up afterwards by the experienced farmer, may form the basis of improvements in his existing system of cultivation.

If such a hope be indulged, it will be perhaps regarded as a fortunate conjuncture of circumstances, that the first establishment of this Professorship should have taken place, not only at a period of peculiar excitement in the agricultural world, when the farmer seems to be awakened to the necessity of endeavouring to rival the manufacturer in enterprise and in invention, but also—as regards the local circumstances of the University in which it has been founded—at a time, when, as I am inclined to flatter myself, an increasing sense seems to be entertained of the duty imposed upon us, of rendering available, for the purposes of instruction, the lectures of the public professors, conjointly with those of the tutors of colleges.

The erection of a Chair of Rural Economy in this University, has filled up the last blank which existed in the series of our professorships, having insured the delivery of lectures, on perhaps the only important branch of human knowledge, which had previously been left unprovided for.

I trust, therefore, that the beneficent intentions of its founder will not be frustrated by a neglect of the means of instruction which he has furnished; for although I do not mean to claim for Rural Economy that same degree of importance that I attach to another science which it is my duty to teach, or conceive, that like Chemistry, it ought to be considered an essential ingredient of a liberal education; yet when I recollect how large a proportion of the youth who resort to Oxford are likely hereafter to fix their abode in the country, I confidently expect, that there will be always some amongst us, to whom the science of Rural Economy may present attractions.

Should such turn out to be the case, I can assure you, that it will be my earnest endeavour, not only to put before you, in my succeeding lectures all such facts and principles of modern science, as may seem to bear in any degree on the details of husbandry, but also to impart, that practical information, which may be gleaned from time to time either from books, or from the obliging communications of those who are actually embarked in agricultural pursuits.

RURAL ECONOMY.

LECTURE II.

In the Lecture on Rural Economy, which I delivered before the University at the close of the preceding Term, my principal object was to explain the advantages, which the art of husbandry was likely to derive, from the assistance that might be afforded it by the sciences of vegetable physiology and of chemistry.

I therefore brought forwards various instances, in which a knowledge of the laws that regulate the growth of plants was calculated to promote materially our success in cultivating them, and pointed out in how great a degree the fertility of the soil, and its adaptation to the wants of man and animals, was affected by its own chemical constitution, and by that of the various manures which might from time to time be superadded to it.

In the present lecture, it is my intention to consider more at length the latter portion of the subject, and to bring forwards in detail the scientific principles upon which the chemical action of manures appears to depend.

It may assist us perhaps, in understanding the mode in which the various matters intermixed with the soil, with the view of improving its quality, may be supposed to operate, if we begin with tracing the successive steps, by which mankind have advanced from the simplicity of early practice, to that more complicated and artificial system of husbandry which prevails in most civilized countries at the present day.

In order to become acquainted with the rude methods adopted in the first ages of the world, it is scarcely necessary to go back to the records or traditions of that period: without giving ourselves this trouble, we may obtain a sufficiently just idea of their mode of procedure, by referring to the practice of husbandry adopted by the early colonists in the wilds of America, or by that in use amongst those, who in the present day emigrate from the eastern portions of the United States into the regions of the far west.

In the virgin land on which the labours of these first settlers were expended, whether it were in Virginia and the Carolinas in the last century, or in Kentucky and Michigan in the present, the expedients for refreshing and invigorating the soil, which are resorted to in older countries, are found to be wholly superfluous.

Judging indeed from the crops obtained for several years after it has been first reduced to cultivation, the ground might in many instances be pronounced to possess an inexhaustible store of fertility, since the same crops admit of being repeated year after year, with no apparent diminution in the amount of produce, and with no further care on the part of the colonist, than that of simply turning up the soil and introducing seed.

Such is represented to have been the case even with the tobacco, when first cultivated by the early settlers in Virginia, where, on land now requiring careful tillage, and yielding but a scanty return, this exhausting species of crop is said to have been repeated year after year without any perceptible diminution.

In Kentucky we are told of soil, that has yielded the finest crops of wheat or of maize, for twenty-five or even fifty successive years, and that without the addition of any kind of manure, whilst in the State of Illinois, some portions of the territory are said to have been cultivated with profit in this same way, from the first period at which the country was settled.

During my late tour through the western portions of the United States, I had frequent opportunities of witnessing the system adopted by those, who first establish themselves in a new settlement.

In these wild regions, unlike to those portions of the globe with which we Europeans are familiar, forest and pasture land are seldom found intermixed, but we meet at one time with vast tracts altogether destitute of timber, and at another with forests, taking such entire possession of the soil, as to leave no intervals for any sort of culture for many hundreds of miles.

The former description of country constitutes the prairies, the latter the woodlands, of North America.

With regard to the former, various theories have been propounded, to account for the entire absence of timber over such extensive tracts.

Monsieur Decandolle offers the following solution :— "The right of prior occupation," he says[g], "explains, how it happens that forests and prairies are found mutually to exclude each other. For if by any cause a forest is established in a given place, the shade of the trees, together with the greediness with which their roots absorb the nutriment, and the manner in

[g] Physiologie, vol. iii.

which the fibres of the latter are interlaced, will prevent the grasses from shooting up underneath. If, on the contrary, the prairie is first developed, then, even supposing that the seeds of the trees do from time to time germinate, yet their roots in the young state cannot easily pierce the close network of roots and stems already existing on the spot, and even if they succeed in doing so, are starved by the voracity of the grass roots, which are more numerous and more developed than their own."

But still the question occurs, what has given to the forest in the one case, and to the meadow in the other, that prior occupancy, to which their power of maintaining entire possession of an extensive tract may perhaps be justly attributed?

It is probable, I think, that in the climate and latitude alluded to, forests would usurp dominion over the greater portion of the country, if no extraneous cause interfered to arrest them. It is only necessary therefore to explain, why large tracts should be found wholly denuded of timber; and this it seems most reasonable to attribute to the practice that prevails amongst the aborigines, of annually setting fire during summer to the plains, in order the more readily to take deer and other wild game.

For the extreme dryness which prevails at that season, causes a fire, when once kindled, to spread in all directions, until it is either stopped by the intervention of a river, or put out by meeting with a ridge, or tract, so entirely destitute of vegetation, as to afford no combustible matter to maintain it.

Hence those vast plains that lie to the west of the Mississippi, not being intersected by any barren range of hills, nor yet traversed by large rivers, have in the course of years been converted into prairies, the growth of timber being from time to time prevented by the cause assigned, until the luxuriant herbage at length so preoccupies the soil, as itself to stifle all other kind of vegetation ; whereas, over a wide tract extending along either side of that great stream, the numerous tributaries that pour their waters into it oppose a limit to the progress of such fires as may occur, and thus enable the forests to maintain their ascendency.

Be this however as it may, we can at least assure ourselves, that the absence of timber in the prairie country is by no means an evidence of sterility—on the contrary, the immense accumulation of decayed vegetable matter, which has resulted from the growth of herbaceous plants during so many centuries, is found to constitute a soil of almost unrivalled productiveness.

The colonist therefore, in first settling down in such a region, has little room for the exertion of any extraordinary skill or industry, having around him an unlimited extent of land, which in its actual condition affords the richest pasturage for his flocks and herds, and which, whenever he takes the trouble of turning it up, and scattering seed over it, will generally repay him largely for the labour expended.

Harder indeed is the lot of him who takes up his abode within the precincts of the primeval forests of the western world, since, before he can reap any advantage from the land he calls his own, he must undertake the severe task of clearing it of the timber with which it is encumbered.

This however being accomplished, it is seldom that he is disappointed in the quality of the soil that lies underneath, and for the most part his rude and imperfect methods of culture afford him for several years as ample a return, as the utmost exertion of skill and experience can secure in the older countries from which he has migrated.

> Aut unde iratus silvam devexit arator,
> Et nemora evertit multos ignava per annos,
> Antiquasque domos avium cum stirpibus imis
> Eruit : illæ altum nidis petiere relictis,
> At rudis enituit impulso vomere campus.

And this was even the case in parts of the Union, which are by no means remarkable for their fertility at present, as for instance in the States of New England.

"When the tract on the green mountains in Massachusetts was first settled," (says Dr. Dwight,) "the same exuberant fertility was attributed to it, which has since characterized Kentucky. From those regions the paradise has travelled to the western parts of the State of New York, to New Connecticut, to Upper Canada, to the countries on the Ohio, to the south western territory, and is now making its progress over the Mississippi into the newly purchased regions of Louisiana. In consequence of the long accumulation of vegetable mould, regions, even if naturally sterile, hold out at first the promise of an abundant return to the cultivator."

Now there is little reason to doubt, that the first Egyptian and Phœnician settlers in Greece, or the first Greeks who peopled the shores of Italy or of Spain, would find themselves placed under circumstances as favourable to husbandry, as the present emigrants in the far West.

It would seem indeed, that the extraordinary exuberance of newly peopled countries, wherever at least the subsoil and climate are such as in any degree to allow of the spontaneous growth of timber, may have given countenance to those visions respecting the Golden

Age, in which the teeming imaginations of the inhabitants of early Greece delighted to indulge, when

> . . . . *καρπὸν ἔφερε ζείδωρος ἄρουρα*
> *Αὐτομάτη, πολλόν τε καὶ ἄφθονον.*

But in the case of the colonist of antiquity, as in that of the settler in the new world at the present day, a period at length must arrive, when the ground, exhausted by unintermitted tillage, would cease to yield him a profitable return, in which case, so long as abundance of good land remained unoccupied, the most obvious course for him to pursue, would be that of abandoning his present possessions, and of advancing further into the vacant territory, until he lighted upon a tract better suited to his purpose.

This accordingly is the practice often adopted in the United States, not only in the newly settled countries of the west, but even in the older States of Georgia and the Carolinas, where the cultivation of cotton, however profitable it may be at first, speedily exhausts the land, and reduces it to sterility; so that in passing through these districts we frequently see estates which had once yielded an abundant return, since abandoned by their possessor, and becoming again a portion of the original wilderness.

And disheartening as it may at first sight appear to him, to submit to the Sisyphean labour of bringing continually fresh land under his dominion, and again to relinquish his conquests after so short a period of occupation, the plan alluded to is the only one which presents itself to the settler in a new country, for restoring to the earth that fertility of which it has thus been deprived.

It is in fact a substitute for the method of fallowing which constitutes the first step in an artificial system of culture; and it seems probable, that the early colonists in the old world may have been led to introduce this latter practice, from having observed that soil, which had become unfruitful in consequence of excessive cropping, gradually resumed its pristine productiveness when abandoned for some time to itself.

For, although in the first ages of the world, the colonists may have adopted the same custom which we find now prevalent in America, and may have pushed farther and farther into the wilderness in proportion as the land already in their possession became exhausted, yet it is evident, that the period for such unrestrained emigration would have long passed away, at the time when, as history informs us, the Pelasgi emigrated into Italy, the Egyptians under Danaus established themselves in the Morea, and the Israelites took possession of the Holy Land.

In all these cases, the colonists were not only destitute of those facilities for moving to great distances, which steam navigation, and the other improvements of modern times afford to the settler in the United States, but were circumscribed in their movements by the hostile tribes that hemmed them in, which, if somewhat lower in the scale of civilization than themselves, were, at least, not so utterly unable to cope with them in the arts of war, as the wild Indian of the present day finds himself, under ordinary circumstances, to be with the back-woodsman of European extraction.

Hence, being more generally obliged to remain stationary upon the spot in which they had at first established themselves, the colonists of old would soon be driven to resort to a system of fallowing, in order to give back to the land a portion of that fertility, of which their mode of culture had in the first instance deprived it.

Accordingly we find in the Hebrew law, every seventh year set apart as a period of entire rest, a command, it is observed, grounded, not only on religious, but also on political and civil considerations, with the view, that is, of preventing the soil from being worn out by continual tillage.

That, which in the Mosaic dispensation had been enjoined as a religious duty, was adopted also in the early times of Greece and Rome from motives of expediency.

Even so late as the time of Virgil, it seems to have been the practice to allow the arable land to lie fallow every alternate year.

> Alternis igitur tonsas cessare novales,
> Et segnem patiere situ durescere campum.

From which it might seem, as if no very marked advance in the principles of husbandry had been made since the Homeric age, considering the lapse of time that had intervened, since it had not yet been fully understood, that a judicious rotation of crops would stand in the place of fallowing, whilst the practice of manuring land, which is the next step in the system of improving it, had already been adopted in the earlier period alluded to.

Thus Homer describes the faithful dog, who alone recognizes his master on his return to Ithaca, as lying neglected upon a heap of dung, with which the labourers were about to manure the farm.

> Δὴ τότε κεῖτ' ἀπόθεστος, ἀποιχομένοιο ἄνακτος,
> Ἐν πολλῇ κόπρῳ, ἥ οἱ προπάροιθε θυράων,
> Ἡμιόνων τε, βοῶντε, ἅλις κέχυτ'· ὄφρ' ἂν ἄγοιεν
> Δμῶες Ὀδυσσῆος τέμενος μέγα κοπρήσοντες·

No notice, it is observed by Cicero[d], is made of manuring by Hesiod, so that we may perhaps conclude, that the practice was of recent introduction at the period when Homer lived.

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[d] De senectute, ch. xv.

In the age of Virgil, however, some progress seems to have been made towards that, which constitutes perhaps the grand improvement of modern times—I mean the rotation of crops; for the Roman poet, immediately after the lines above quoted, in which he recommends the arable land to lie fallow every alternate year, adds

Aut ibi flava seres, mutato sidere, farra,
Unde prius lætum siliqua quassante legumen,
Aut tenuis fœtus viciæ, tristisque lupini
Sustuleris fragiles calamos, sylvamque sonantem.

Shewing his acquaintance with the fact, that the substitution of pulse or other leguminous plants will refresh the soil, as well as the practice of fallowing, "for thus too," says he, "by a change of crop, the ground is made to rest."

Sic quoque mutatis requiescunt fœtibus arva.

This passage of Virgil, Pliny explains in a manner which proves, that the Romans, though conscious of the utility of alternating leguminous with farinaceous crops, or, as we now express ourselves, restorative with exhausting ones, did not seem to know, that a rotation might be introduced, which should entirely supersede the necessity of fallowing in many soils, and render its recurrence much less frequent in all.

"Virgilius," he says, "alternis cessare arva suadet, et hoc, si patiantur ruris spatia, utilissimum procul dubio est. Quod si neget conditio, far serendum, unde lupinum, aut vicia, aut faba, sublata sunt, et quæ terram faciant lætiorem."

He also says in another place that a crop of beans enriches the ground like manure,

Solum, in quo sata est, lætificat, stercoris vice.

Whatever therefore may be the comparative merits of the ancient and modern systems of husbandry in other respects, it would seem that in this one at least a vast step has been gained since the days of Virgil and Columella. Nor are we less in advance of these writers in the article of manures, which, no longer limited, as with them, to animal and vegetable matters in a state of decomposition, or to lime and certain kinds of marl, comprehends at present a great variety of mineral substances, with which the ancients were wholly unacquainted.

Amongst these we may enumerate, 1. phosphate of lime or bone dust, so useful in the turnip, potatoe, and grass land of this country; 2. the nitrates of potass and of soda, which are said to increase our crops of wheat and other cereal grasses in a remarkable manner; 3. barilla, or kelp, which has also been employed with success for corn-crops; 4. common salt, which is considered beneficial to the same on light soils; and 5. gypsum, the efficacy of which is admitted in leguminous crops, and will probably be found to extend to others also.

None of the above manures, it is probable, were known by the ancients, though Virgil recommends nitrum[k] (which appears to have been carbonate of soda or potass, and not, as commonly translated, saltpetre,) mixed with the dregs of oil, as a steep to make the seed-grain swell.

> Semina vidi equidem multos medicare serentes,
> Et nitro prius et nigra perfundere amurca,
> Grandior ut fetus siliquis fallacibus esset,

and suggests our scattering over the exhausted land ashes, which probably derived their fertilizing property in great measure from the gypsum they contain,

> ———————————— neve
> Effetos cinerem immundum jactare per agros.

The great advance indeed which has been made within two centuries only in the art of husbandry, may be calculated from this one fact alone, namely, that the population of England in the time of Queen Elizabeth amounted, according to the estimate of Guicciardini, to not more than two millions, whereas at present it probably exceeds fourteen; yet there is no question, but that the present inhabitants are better fed than were their ancestors, although it can hardly be supposed, that the quantity of land now in cultivation exceeds seven times that which had already been brought under tillage in the year 1600 [k].

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[k] See Beckman's History of Inventions.

Something indeed must be allowed for the amount of corn introduced into England from foreign countries, which in 1831 (in which year a larger quantity had been imported than at any period before or subsequent) was estimated at 3,541,809 quarters, being less than one-fourteenth of the whole quantity consumed in the United Kingdom [l]. But even with this deduction there will remain a sufficient overplus, to evince the greater productiveness of the soil under its present management, than under that of our ancestors.

Let us not, however, indulge too much in a feeling of self-satisfaction when contemplating our proficiency in the art of husbandry, for considerable as the advances may be, which have been made from the first rude efforts of the earliest occupants of the soil, yet still greater, it may be suspected, is the distance which separates us from that ideal goal, towards which the efforts of the agriculturist ought to be directed, at which empiricism would give place to principle, and theory direct with ease and certainty the operations of the husbandman.

"As there is no profession," says Liebig[m], "which can be compared in importance to that of agriculture, so there is none, in which the application of correct principle would be productive of more beneficial effects. Hence it appears quite unaccountable, that we may vainly search for a single leading principle relative to this subject in all the writings of agriculture and of vegetable physiologists."

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[k] See Appendix.

[l] See Macculloch's Comm. Dict. p. 417.

[m] Organic Chemistry in its Applications to Agriculture, p. 138.

"The methods employed in the cultivation of land are different in every country and in every district; and when we inquire the causes of these differences the answer we receive is, that they depend upon circumstances (*les circonstances font les assolements*). No answer could shew ignorance more plainly, since no one has ever troubled himself to ascertain what these circumstances are. Thus also, when we inquire in what manner manure acts, we are answered by the most intelligent men, that its action is covered by the veil of Isis; and when we further demand what this means, we discover merely that the excrements of man and animals are supposed to contain an incomprehensible something, which assists in the nutrition of plants, and increases their size. This opinion is embraced, without even an attempt being made to discover the component parts of manure, or to become acquainted with its nature."

Whilst an eminent chemist expresses himself in these terms with respect to the labours of physiologists, the judgment passed upon the researches of chemists by a distinguished botanist of our own country is not more favourable, since he quotes with approbation a remark which had been made to him by a friend, to the effect "that chemistry has hardly advanced the art of agriculture a single step, but that the latter remains, after all the investigations of the chemists, a mere empirical art [n]."

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[n] Lindley's Introduction to Botany.

I trust, what I have said in my former lecture will convince you, that both these general statements must be received with some grains of allowance, and that both chemistry and vegetable physiology have already rendered good service to agriculture; but it cannot be denied that experience and tradition are still the main sources to which the farmer usually looks for information, and that science is as yet far from having shed any steady light over the obscurity in which his processes are veiled.

It is evident, that in order to determine in what precise manner the different kinds of manure can improve the condition, and increase the quantity of the plants exposed to their influence, it will be necessary in the first place, to ascertain from what source or sources vegetable substances obtain their nourishment, and it is certainly somewhat humiliating to reflect, that notwithstanding the attention paid to the elucidation of this subject by many distinguished men of science, a question so fundamental should have remained in part unanswered, until the celebrated German chemist, Liebig, applied himself to its investigation.

The elements of which the structure of every perfect plant consists, may be referred to two distinct classes: namely, such as are capable of being received into the vegetable organization in the condition of a gas, and such as are not.

The former class of elements comprehends oxygen and hydrogen, which, either separately or in the condition of water enter into the constitution of every plant; carbon, which though of a fixed nature when alone, is converted into a gaseous state when combined either with oxygen or with hydrogen; and nitrogen, which is volatile both when alone, and when in combination with hydrogen, as ammonia.

The three former are universally present in plants, the latter more commonly so than was formerly supposed, although in smaller proportion than the rest; and as all four, though present in the soil, are also capable of volatilization, or in other words, of existing permanently in the atmosphere, it is quite open to conjecture, whether plants obtain their elements from the one source or from the other.

The second class of constituents, comprehending substances found in plants which are incapable of being converted into vapour at such temperatures as they are exposed to in nature, consist of the alkalies, earths, and metallic oxides, which by their presence give firmness and solidity to the vegetable structure, and perhaps, by being interposed between the particles of living fibre, may contribute in some other manner, as yet imperfectly understood, to impart to it the properties it possesses [o].

These of course cannot be conveyed through the medium of the atmosphere, and hence the natural inference would seem to be, that they are derived from the soil in which the plants are fixed.

Yet this conclusion has been combated by many physiologists, who allege, that the above ingredients are found in plants even when not present in the soil from which they proceed, and a German chemist, Schrader, was honoured with a prize from the Berlin Academy, for having, as was thought, established this position.

Saussure, however, has shewn, that the same plant, when grown upon a calcareous soil, contains more calcareous matter than it does in a siliceous one, and I have myself instituted a series of experiments, which tend to demonstrate, that in proportion as you deprive a vegetable of all external means of obtaining its fixed constituents, in that degree you diminish the quantity of them, which it will contain; whence the natural inference would seem to be, that if it were possible to intercept completely all the channels by which it could derive these principles, none such would be present in its composition[p].

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[o] See Dr. Prout's Treatise on the Stomach, &c. introduction, and my Introduction to the Atomic Theory, p. 30.

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[p] The following were the results obtained in the experiments alluded to:—

In experiment I. the object was merely to determine the variation, in the amount of solid ingredients obtained, which might be referred to differences in the soil, or to different exposure to atmospheric influences. In experiment II. and III. it was also intended to ascertain, by watering the plants with a solution of nitrate of strontian, whether the quality of the earthy ingredients might be made to vary *ad libitum* according to the nature of those presented to their roots in a soluble form. In the tabulated results given underneath, the portion soluble in water represents the amount of carbonates, that soluble in acid the amount of sulphates and of phosphates present.

EXPERIMENT I.

LOTUS TETRAGONOLOBUS.	Ashes.	Portion soluble.		Portion insoluble in these menstrua.
		In water.	Nitric acid.	
780 grs. of the seeds containing....	30	5.2	3.4	only a trace
Being planted in a greenhouse.				
1. In sulphate of strontian [a]. Produce when dried 4002 grs.	60.0	very small	17.15	not estimated
2. In Carrara marble. Produce dried being 2233 grs.	67.5	1.8	20.9	not estimated
3. Sea sand. Produce when dried 1135 grs.	34.3	4.1	6.0	not estimated
In a garden.				
1. In sulphate of strontian. Produce when dried 4862 grs.	94.0	0.72	27.2	not estimated
2. Carrara marble. Produce when dried 3267 grs.	64.5	a trace	28.2	1.5
3. Sea sand. Produce when dried 2957 grs.	67.0	a trace	16.0	8.8
4. Common garden mould. Produce when dried 5267 grs.	82.25	16.8	13.85	5.0

[a] The sulphate of strontian was far from pure, and therefore might easily furnish the earthy ingredients which the plants contained.

Thus the latest experiments confirm, what both reason and analogy tend to suggest, and relieve us

EXPERIMENT II.

LOTUS TETRAGONOLOBUS.		Ashes.	Portion soluble. In water.	Portion soluble. Nitric acid.
600 grs. of the seeds		23.0	4.0	2.6
Planted in a greenhouse, and watered with a solution of nitrate of strontian containing 2 ounces of the salt to 10 gallons of water.				
1. In sulphate of strontian.				
Produce dried { Parts above ground	170	22	6.65	2.65
Roots &c.........	107	40	0.48	5.60
	277	62	7.13	8.25
2. In Carrara marble.				
Produce dried { Parts above ground	150	19	3.70	16.3
Roots, &c.......	152	34	3.20	37.0
	302	53	6.90	53.3
3. In washed sea sand.				
Produce dried { Parts above ground	34	5	2.3	1.4
Roots, &c.	100	6	1.4	1.7
	134	11	3.7	3.1
4. In flowers of sulphur.				
Produce dried { Parts above ground	100	6	2.6	2.9
Roots, &c.	108	5	2.6	1.9
	208	11	5.2	4.8

EXPERIMENT III.

		Soluble portion of these ashes.				
		In water.	In nitric acid.			
				After being treated with an alkaline carbonate.		
HORDEUM VULGAREM	Weight of its ashes.		Without previous treatment.	Earthy phosphate.	Earthy sulphate.	Portion insoluble in their menstrua.
300 grs. containing........	7.7	1.53	1.68	......	0.45	2.04
Planted in a greenhouse, and watered in a solution of nitrate of strontian, containing 2 ounces of the salt to 10 gallons of water.						
1. In sulphate of strontian. Produce dried 383 grs.	61.0	13.3	17.0	3.6	1.3	0.9
2. In Carrara marble. Produce dried 230 grs.	34.0	7.8	14.5	......	2.5	0.8
3. In washed sand. Produce dried 260 grs.	45.0	10.5	5.9	0.9	2.5	2.1
4. In flowers of sulphur. Produce dried 78 grs.	7.0	0.9	4.0	none	none	0.1

See Linnæan Trans. vol. xvii. part II.

from the necessity of resorting to a supposition so paradoxical, as that of attributing to the vegetable organization, the power of itself elaborating the alkaline or earthy matters which it may chance to contain[p].

It follows then, that whichever of this class of constituents enters necessarily into the fabric of the vegetable, must be present also in the soil in which it grows, and hence we may derive an important lesson, as to the application of the substances employed as mineral manures in encouraging the growth of particular plants, and also as to the injurious effects of certain crops upon the growth of those which are to succeed them.

Every known vegetable seems to contain a given proportion of alkali—soda near the sea, potass in places more inland.

The former of these may readily be referred to the salts present in the waters of the ocean, whilst the latter may be supplied by the decomposition of those rocks into which it enters as an ingredient.

But the decomposition of a rock proceeds only at a certain and that a very slow rate, and until it is complete, the alkali will be retained by an affinity much too powerful, to allow of its being extracted by the absorbing surfaces of the roots.

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[p] Lampadius has lately instituted some experiments, which seem at first sight to militate against the notion, that the inorganic constituents are dependant on the nature of the soil in which they grow. He divided a piece of ground into five equal parts, each twenty feet square; after measuring them equally, he strewed over the first 5lbs. of finely powdered quartz; over the second, the same quantity of ammonia; over the third, as much chalk; over the fourth, as much of carbonate of magnesia; the fifth being left without any addition. A certain quantity of wheat was sown in it and the crop analyzed, but no difference in their respective fixed ingredients was discoverable. Mayer, however, justly observes, that these experiments prove nothing, because the earths added were not in a soluble condition, and therefore could not affect the constitution of the plants.

Hence, supposing the crop already raised on a field to have absorbed all the alkali which the subsoil at the time contains, it is evident, that no second crop of the same description can succeed, until the ground has lain fallow long enough, to admit of a fresh supply of alkali being obtained by a continuance of the process of disintegration, or until this necessary ingredient has been added to it from without.

Hence the advantage in these cases of such manures as wood-ashes, because they contain much potass, and even of the excrements of animals, since these also are not destitute of that principle.

Another ingredient present in all vegetables that yield nourishment to man, and especially so in the different kinds of bread-corn, is phosphoric acid.

This substance is found in many minerals and mineral waters, and even, according to Liebig, in all land anywise capable of cultivation, so that the barren heath of Luneburg contains an appreciable quantity of it.

I recollect some years ago, when Dr. Buckland was pursuing his researches on coprolites, which consist chiefly of phosphate of lime, that I endeavoured to assist him by searching for this substance in a variety of rock specimens taken from different localities, but that I soon gave up the pursuit, finding traces of its presence so generally, as to be led to conclude, that no inference, as to the presence of coprolitic matter, could be satisfactorily deduced, from the mere existence of phosphate of lime in the containing rock.

Under the circumstances stated, we cannot wonder, either that bone-dust, which mainly consists of this material, should prove so excellent a manure when applied for the first time upon land, or that it should lose its efficacy on repetition—that is, when the soil has become already sufficiently charged with this principle to furnish to the plants all of it which they require.

The necessity of deriving from the ground whatever fixed ingredients enter into the constitution of any particular plant, explains in part the advantage of a due admixture in the subsoil of all the more common earths. A certain quantity of silex, of lime, of magnesia, seems to be essential, and hence a soil consisting wholly of one of these earths is generally found to be unproductive.

I have likewise shewn, in some experiments which I made some years ago[q], that when an earth, which does not naturally enter into the constitution of a plant, such as strontian, is presented to it even to the exclusion of others, little or none can be detected within the vegetable tissue, so that it either is not absorbed, or is again excreted, by the roots, and this conclusion I find to be corroborated by Liebig in the volume already referred to.

It may appear singular, that under these circumstances, a substance having such a resemblance to lime, as strontian possesses, cannot be substituted for it, especially when it has been found, that the proportions of the several earths and alkalies which enter into the composition of a plant vary according to external conditions. Thus I have already stated, that the same plant grown on a calcareous soil contains more lime, and less silex, than it does in a siliceous one, and *vice versâ*.

But it has been shewn by Liebig, that the total amount of the bases present never varies, the excess of one making up for the deficiency of the rest. Thus, according to Saussure, one hundred parts of the ashes of a fir, growing the magnesian soil of Mount Breven, contained :

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[q] Linnæan Trans. vol. xvii.

Carbonate of potass	3.60	Sum of oxygen in the potass	0.41
——— lime	46.34	——— lime	7.33
——— magnesia	6.77	——— magnesia	1.27
Sum of the carbonates	56.71	Sum of the oxygen in the bases	9.01

whilst one hundred parts of the ashes of the same tree grown on the soil of Mount La Salle, which contained no magnesia, consisted as follows, of :—

Carbonate of potass	7.36	Sum of oxygen present in potass	0.85
——— lime	51.19	——— lime	8.10
——— magnesia	00.00	——— magnesia	0.00
Sum of the carbonates	58.55	Sum of the oxygen in the bases	8.95

Again, Berthier has analyzed the ashes from two fir trees, one growing in Norway, the other in France (Dep. de l'Isere).

That from Norway contained in one hundred parts :

Potass	14.10	of which	2.4	parts would be oxygen
Soda	20.70	———	5.3	———
Lime	12.30	———	3.45	———
Magnesia	4.35	———	1.69	———
	51.45		12.84	

That from France, on the contrary, contained in one hundred parts :

Potass and soda	16.8	in which	3.42	parts would be oxygen
Lime	29.5	———	8.20	———
Magnesia	3.2	———	1.20	———
	49.5		12.82	

Thus in both cases, variable as the proportions of the different bases were, the amount of oxygen present in them collectively was as nearly as possible the same.

And what renders the last result more remarkable is, that in the fir-wood from Norway the amount of soluble salts was fifty, in that from France only twenty-five per cent. The bases in the former were in combination wholly with organic acids, those in the latter partly with organic, and partly with mineral ones, such as the sulphuric, phosphoric, and muriatic. Yet even here, as we have seen, the amount of oxygen present in the bases collectively, and in consequence their saturating power, corresponded almost precisely.

Why then, it may be asked, cannot a new earth, like strontian, take the place in a plant of those which form a part of its ordinary constitution?

It is possible, that the difference of crystalline form, which exists between the substances under consideration, may render the substitution of one for the other in the structure of the living plant, impossible. Lime, it is to be remarked, is *isomorphous* with magnesia, and even in some cases replaces potass and soda. We can therefore understand how it happens, that one of these bases may be substituted for the others in plants, as well as in minerals; but between them and strontian no isomorphism exists[r], and hence there may be some mechanical reason, why this substance is unsuitable to the vegetable organization[s], and therefore cannot replace the bases in question.

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[r] We should have expected, that two substances, which correspond so nearly, in structure, in chemical properties, and in relations to other minerals, as isomorphous bodies appear to do, should produce analogous effects upon the functions of vitality. Yet it is found, that barytes is highly poisonous, strontites innocuous, and in like manner that arsenic is most destructive to life, whilst phosphorus enters necessarily into the constitution of all animal and of many vegetable structures.

The latter circumstance is the more extraordinary, if it be true, as Orfila has stated, that arsenic acid in minute quantities is present in the bones of man and other animals, as this would seem to imply a transformation of one substance hitherto regarded elementary into another.

Should this fact be substantiated, it would seem well worth the attention of physiologists to discover, whether the existence of a larger amount of arsenic in the constitution, resulting from disordered actions, may not be a new and hitherto unsuspected source of disease.

But notwithstanding the deservedly high authority on which the assertion rests, its extreme improbability may induce us to suspend our belief, until further evidence of its correctness shall have been adduced.

There would seem, however, to be a limit to this power of substitution, even in the case of substances, which enter naturally into the constitution of the vegetable, and which are isomorphous one with the other, for we cannot otherwise explain, why it is, that wheat will not flourish in a sandy or even in a calcareous soil, unless a considerable quantity of clay be also present, the latter being required to furnish a sufficient proportion of alkali, which the other earths do not contain?

Accordingly, fir-trees and other evergreens grow well in sandstone and in limestone, whilst those which shed their leaves thrive better on rocks of a granitic character, for the latter require more alkali, and can procure a larger supply of that constituent from felspathic materials.

But the inorganic matters already alluded to constitute, after all, an inconsiderable part of the vegetable structure, when compared with those volatilizable principles which accompany them in plants.

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[s] Von Buch has offered some ingenious remarks, in a memoir on the silicification of organic bodies, published in the Transactions of the Berlin Academy, which seem to illustrate this latter position. "The skeleton of animals," he remarks, "would have become very different, had nature had another substance to work with than phosphate of lime, the axes of which are unequal. Such minerals only, as have unequal axes, i. e. in which there is one axis of greatest contraction, can become fibrous or extend themselves in rays. They are those minerals, in which the axis of the ray is always at the same time the axis of the greatest contraction. This axis even decides the predominant direction of the shooting out of the rays. It is only in such minerals, that these rays can so arrange themselves together as to form a thin covering."

"Were the secreted substance one having equal axes, like fluor-spar for instance, the organic life would have had thus great difficulty in arranging the particles of fluor-spar when formed. Instead of rays and plates, masses would have been produced; and the skeleton, and with it the entire animal, and its capabilities, would have been completely different from what they actually are."

It becomes therefore a still more important inquiry, from whence do the latter derive the carbon, the hydrogen, the oxygen, the nitrogen, which they all appear to contain? Do these principles proceed from the soil, or from the atmosphere, or must we conclude that both the one and the other contribute to supply them?

Until within the last century, it would have been taken for granted, that the soil was the source from whence proceeded all the solid matter at least which entered into the constitution of a plant, and there were several circumstances which tended to countenance such an opinion. No plants, it was observed, would continue long to thrive in earth unmixed with some proportion of vegetable mould, and the fertility of the latter is greatly enhanced by the addition of animal or vegetable matter, in that state of decay, in which it becomes soluble in water, and therefore fitted to obtain admission into the vessels of plants.

Hence, when Priestley had demonstrated, that leaves decompose the carbonic acid of the atmosphere, giving out its oxygen and assimilating its carbon, the doctrine alluded to still to a certain extent maintained its ground; and it was even questioned by Ellis and others, whether in fact, if we were to strike the balance between the opposite influence of a plant during the day and the night, as much carbonic acid might not be exhaled by it at one period, as had been decomposed at another.

I was therefore induced myself to undertake some experiments[t], the results of which appear to establish, that plants, even in a confined atmosphere, do in reality add a great deal more oxygen to the air than they abstract from it, whilst the amount of carbonic acid which may be introduced undergoes at the same time a corresponding diminution.

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[t] See Philosophical Transactions for 1836.

This effect I even found to take place in diffused light, as well under the direct influence of the solar rays, and to be no less common in aquatic that in terrestrial plants.

I also shewed, that when a branch loaded with flowers, as well as with leaves, was introduced into a jar containing a certain proportion of carbonic acid, the balance still continued to be in favour of the purifying influence of the vegetable.

The apparatus I made use of consisted of a large bell-glass jar, containing in one case 600, in another 800 cubic inches of air[m], and suspended by pulleys. Its edges dipped into quicksilver, contained in a double iron cylinder of corresponding dimensions to the jar, which, being closed at bottom, constituted a well of about six inches in depth, calculated to receive a fluid, and to admit of the glass vessel moving freely in it. The inner margin of this hollow cylinder was cemented air-tight, according as circumstances required, either to a plate of iron, or to a pot of the same material upon or in which the plant operated on might be placed; and the jar was then let down upon it, until its edges were sunk a little beneath the surface of the mercury.

Thus all communication with external atmosphere was cut off, and the effect of the plant upon the air inclosed in the jar was readily measured, by simply pressing down the latter, and thus expelling a portion of its contents through a tube, communicating with its interior, and introduced at its outer extremity under a pneumatic trough, wherein the air might be collected and examined. By connecting this extremity with a vessel containing a measured quantity of carbonic acid, and raising the jar a little in the well of mercury, it was easy to draw in any proportion of that gas, with which it was thought proper that the plant should be supplied. A portion of the air was always tested, immediately after the introduction of every fresh portion of carbonic acid, and again after an interval of some hours, and the proportion of this gas and of oxygen present was each time carefully registered. The amount of carbonic acid was determined by a solution of potass, that of oxygen by the rapid combustion of phosphorus with a portion of it introduced into a bent tube.

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[m] Larger jars, containing from 1200 to 1300 cubic inches, were latterly employed.

Such was the mode of procedure, when an entire plant became the subject of experiment; but some of the most satisfactory trials were with branches of certain shrubs, themselves too large to be admitted under the jar. These branches, without being detached from the parent trunk, were introduced through a hole in the centre of two corresponding semicircular plates of iron, which were cemented air-tight, to the inner margin of the iron cylinder on the one hand, and to the stem of the branch on the other. In this manner, when the jar came to be placed over them, and to dip beneath the surface of the mercury, the external air was as effectually excluded, as when the whole of the plant had been inclosed.

The results of several experiments conducted after this plan are given in a tabular form in the Memoir; but it may be sufficient here to specify one of the most satisfactory of those undertaken. In this case the jar itself contained about 600 cubic inches of air, and the plant experimented on was the common lilac (*syringa vulgaris*). The proportion of carbonic acid in the jar was each morning made equivalent to five or six per cent. by additions through the tube.

The first day no great alteration in the air was detected, but on the second day, by eight in the evening, the oxygen had risen to 26.5 per cent. In the morning it had sunk to 26.0, but by two p.m. it had again risen to no less than 29.75, and by sunset it had reached 30.0 per cent. At night it sunk one-half per cent.; but the effect during the following day was not estimated, as the sickly appearance which the plant now began to assume induced me to suspend the experiment.

In a second trial, however, the branch of a healthy lilac growing in the garden was introduced into the same jar, where it was suffered to remain until its leaves became entirely withered.

The first day the increase of oxygen in the jar was no more than 0.25 per cent., but on the second it rose to 25.0. At night it sunk to nearly 22.0 per cent., but the next evening it had again risen to 27.0. This was the maximum of its increase, for at night it sunk to 26.0, and in the morning exhibited signs of incipient decay. Accordingly in the evening the oxygen amounted only to 26.5; the next evening to 25.5; the following one to 24.75; and the one next succeeding it had fallen to the point at which it stood at the commencement, or to 21.0 per cent.

The reason of this decrease was, however, very manifest from the decay and falling off of the leaves; so that this circumstance does not invalidate the conclusion which the preceding experiments concur in establishing, namely, that in fine weather a plant, so long at least as it continues healthy, adds considerably to the oxygen of the air when carbonic acid is freely supplied.

In the last instance quoted, the exposed surface of all the leaves inclosed in the jar, which were about fifty in number, was calculated at not more than 300 square inches, and yet there must have been added to the air of the jar as much as 26.0 cubic inches of oxygen, in consequence of the action of this surface upon the carbonic acid introduced.

But there is reason to believe, that even under the circumstances above stated (which appear more favourable to the due performance of the functions of life than those to which Mr. Ellis's plants were subjected,) the amount of oxygen evolved was much smaller than it would have been in the open air, for I have succeeded, by introducing several plants into the same jar of air in pretty quick succession, in raising the amount of oxygen contained from twenty-one to thirty-nine per cent., and probably had not even then attained the limit to which the increase of this constituent might have been brought.

How great then must be the effect of an entire tree in the open air under favourable circumstances! and we must recollect that, *cæteris paribus*, the circumstances will be favourable to the exertion of the vital energies of the plant, within certain limits at least, in proportion as animal respiration and animal putrefaction furnish to it a supply of carbonic acid.

These experiments were published in the Philosophical Transactions for 1836, and have been noticed in Dr. Lindley's popular Introduction to Botany; neither am I aware that the deductions which were drawn from them have any where been disputed: I know not therefore to what class of physiologists Professor Liebig can allude, when he asserts[n], that the source from whence plants obtain their carbon is still doubted, nor to whom he may address the arguments, by which he thinks it necessary to support a doctrine, which, in this country at least, is considered so fully established.

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[n] Chemistry applied to Agriculture, p. 26.

We are, however, indebted to him for explaining, more clearly than had hitherto been done, how it happens, that if the atmosphere be the source of the carbon present in the constitution of a plant, the growth of the latter, is so materially influenced by the quality of the mould with which its roots are in contact, and also why it is, that without the presence of this substance it speedily languishes and dies.

In order to account for this, Professor Liebig begins by shewing, that vegetable mould contains in general two principles, both of which have often been confounded under the common designation of *humus.*

The first of these, which is soluble in alkalies and in certain of the earths, has been termed *humic acid,* although, correctly speaking, the latter is the substance produced from that description of humus which is in a state to be acted upon by alkalies, in consequence of their operation upon it.

The second principle, which should be distinguished by the term *coal of humus*, is indeed derived from the former by the gradual process of decay, but is already advanced to that condition, in which neither alkalies nor earths can convert it into humic acid, nor render it soluble.

Now humus, in common with all carbonaceous substances which contain a small proportion of hydrogen, undergoes, when slightly moistened, a process of slow combustion, which may consist, either simply in an absorption of oxygen, in which case nothing will be given off, or in the production of carbonic acid, when of course that gas will be disengaged.

The slowness with which the latter takes place, and the absence of that sensible heat and light which accompany ordinary combustion, have led Professor Liebig to distinguish this process by the term *eremacausis*, from ηρεμα by degrees, and καυσις burning.

Now this slow combustion goes on in woody fibre, from the first commencement of its decay, till it passes into that description of humus before described, which is insoluble in earths and alkalies.

During the intermediate stages, it constitutes humus of the former description, which, as already stated, when acted upon by these substances, is converted into humic acid, and combines with them.

During the whole period of its decay, until it has reached that ultimate point, at which it ceases to be soluble, and has become a kind of *caput mortuum*, it goes on continually disengaging carbonic acid, so that the roots of plants fixed in humus of this quality, are surrounded by an atmosphere of the gas in question, which is therefore held in solution by the water taken up by them as sap.

Humus, then, by means of the carbonic acid which it emits, does supply food indirectly to the plant, but that it communicates nothing to it directly, appears from the fact, that it is itself almost wholly insoluble in water, and can only be dissolved by it when in union with an alkali or an earth. Hence the amount of humus, or humic acid, which enters the vegetable tissue, must at least be limited by the quantity of earthy and alkaline matters which are absorbed, and how small that quantity is, may be seen by reference to the statement I have already made, as to the weight of ashes in a given portion of a plant.

We seem therefore to be justified in attributing the carbon which plants contain exclusively to the decomposition of carbonic acid, which, before the leaves are developed, is introduced together with the sap by the roots, but afterwards is obtained directly from the air itself. Hence the larger tribes of the vegetable kingdom draw little from the soil, or rather excrete by their roots more carbon than they absorb, whilst the extensive surface exposed to the atmosphere by their leaves, enables them to perform that important office, which is assigned to them in the economy of nature,—of purifying the atmosphere, polluted by the breath of so many millions of animals, as well as by other operations connected with the existence of the human species.

It is remarked by Liebig, that in early periods of the earth's history, the gigantic monocotyledonous plants—the ferns, palms, and reeds, with which the surface of the globe was overspread—belonged to a class, to which nature has given the power, by means of an immense extension of their leaves, to dispense with nourishment from the soil. Hence the enormous amount of carbon locked up within the earth in the shape of coal, the whole of which was originally obtained from the carbonic acid afforded by the atmosphere.

But it would seem necessary to attribute to the living vegetable the power of decomposing, not merely carbonic acid, but also water.

This indeed has been shewn, by M. Colin and Edwards in their experiments on the respiration of plants, and likewise by M. Boussingault; nor can we otherwise account for the fact, that wax, resin, and several other vegetable products contain an excess of hydrogen, over and above that required to constitute water with the oxygen present.

It would seem, I think, from the late important researches of M. Payen, that the decomposition of water commences subsequently to that of carbonic acid, whether it be, that the former process requires a greater development and energy in the vegetable functions, or that it takes place in organs of a different description and of later growth.

M. Payen seems to have established, that under the general term of ligneous fibre, or lignin, we have hitherto confounded at least two distinct substances, namely, that which constitutes the walls of the cells, and that which, by being deposited afterwards on the surfaces of the latter, imparts to them the solidity of texture which woody fibre possesses.

He has succeeded in isolating the two by chemical means, and has found, that whilst the cellular matter has exactly the same composition as starch, being composed of 44.9 carbon, 6.1 hydrogen, 49 oxygen, or 44.9 carbon and 55.1 of water; the incrusting matter afterwards formed consists of 53.76 carbon, 40.2 oxygen, and 6 of hydrogen, or of 53.76 carbon, 45 of water, and 1 of hydrogen.[n]

The composition of the ligneous matter of different kinds of wood will therefore vary according to the relative proportion of these two ingredients, as is shewn in the following table of M. Payen :—

LIGNEOUS BODIES.	Carbon.	Hydrogen.	Oxygen.	Incrusting matter.
Incrusting matter of the wood	53.76	6.00	40.20	100
Wood of Saint Lucia	52.90	6.07	41.03	90
Ebony	52.85	6.00	41.15	89
Walnut	51.92	5.96	42.12	82
Oak	50.00	6.20	43.80	61
Ditto according to Gay-Lussac, and Thenard	51.45	5.82	42.73	
Beech	49.25	6.10	44.65	52
Cellular matter	44.90	6.10	49.00	00

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[n] Payen has since stated, that this incrusting matter probably consists of two or three different principles.

This then proves, that, in the formation of the matter which incrusts and fortifies the walls of the cellular tissue in wood, though not in that of the cellular tissue itself, a decomposition of water must have taken place ; since the 1 per cent. of hydrogen which Payen has found in excess, can only have arisen in this manner.

This increase of hydrogen becomes still greater, when in the progress of vegetation, the plant begins to secrete oils, camphors, and other analogous bodies, products, which, it is to be remarked, abound most within the tropics, where the light of the sun is most intense.

Hence the decomposition of water, no less than that of carbonic acid, seems due to solar influence, and accordingly, the greater sweetness of subacid fruits, in a warm than in a cold summer, arises from the transformation of a larger amount of tartaric or other vegetable acids into sugar, owing to that separation of oxygen from the former which is accomplished by the agency of light.

The process of assimilation of plants in its most simple form may therefore be stated, as consisting in the extrication of hydrogen from water, and of carbon from carbonic acid, in consequence of which one of three things must happen—either all the oxygen of the water and of the carbonic acid are separated, as in those bodies which, like caoutchouc, volatile oils, &c., consist of nothing else but carbon and hydrogen ; or, secondly, only a part of it is exhaled, as in the case of the incrusting matter of wood, and in sugar ; or, thirdly, that, belonging to the carbonic acid alone is decomposed, whilst the water remains, as in starch and cellular tissue.

But there is yet another ingredient, which is present, although generally in minute proportions, in many vegetable principles, and which therefore must be furnished to them from without, in order that their remaining constituents may become assimilated; for it is evident, that however small the amount of any one of the component parts of a compound may be, still its presence is just as essential as that of the rest.

This ingredient is nitrogen, which exists in the seeds of most plants, and seems essential to all those vegetable principles that afford the staple from which animal life obtains its support.

The dependence of the nutritive qualities of various articles of food upon the proportion of nitrogen is well shewn in a recent memoir of Monsieur Boussingault[p], who gives, on the authority of the celebrated agriculturist Von Thaer, a scale of the relative degree of nutriment afforded by various plants to cattle, and then places by the side of it a statement of the proportion of azote present in them, from which it appears, that the nutritious quality of each bears a pretty constant ratio to the quantity of nitrogen they contain.

This may be seen by the following table:

	Equio.	
Ordinary hay	100	its azote being 0.0118
Red clover	90	0.0176
Beans	83	0.0141
Wheat-straw	400	0.0020
Potatoes	200	0.0037
Beet	397	0.0026
Maize	59	0.0164
Barley	54	0.0176
Wheat	27	0.0213

When we reflect indeed, that animal matter, which so abounds in nitrogen, is nevertheless derived, either directly or indirectly, from vegetable, it follows, as a

[p] Annales de Chemie, vol. lxiii.

necessary consequence, that existence can only be maintained by the aid of those principles in plants, which contain a certain proportion of the element alluded to.

And this has been shewn by the experiments of Magendie upon dogs, who were fed on sugar, starch, gum, and other substances destitute of nitrogen, and in a very short time pined away and died.

Now, in inquiring as to the source from which plants derive their nitrogen, it might at first sight strike us, that the atmosphere itself, which contains as much as 80. per cent. of this gas, would supply it. To this supposition, however, there appear to be grave objections, from the indisposition which nitrogen evinces to enter into combination with any elementary substances, excepting oxygen and hydrogen[p]. With the latter indeed, it is only when in what is called a *nascent* state that it will unite, nor do bodies containing either hydrogen or oxygen in combination exert for it the smallest affinity.

Liebig therefore concludes, that it is furnished to plants by the decomposition of ammonia[q], a compound of nitrogen with hydrogen, which from its solubility in water and in acids, together with the facility with which it is resolved into various and opposite forms, seems exactly calculated to enter into the vegetable organization, and to supply the nitrogen which it requires.

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[p] It unites indeed with carbon, chlorine, &c., but only through the intervention of other substances.

[q] May it not also be true, that the converse likewise occurs in some cases, and that hydrogen is assimilated whilst nitrogen is disengaged. This I am inclined to suspect, from having observed, in the course of my experiments with respect to the action of light upon plants, that certain cruciferæ, which, from requiring animal manure, would seem to absorb a large amount of ammonia, sometimes exhale pure nitrogen.

See my Memoir in the Philos. Transactions for 1836.

But is ammonia so uniformly present wherever plants are to be found, as the foregoing explanation appears to assume?

Considering that this gas is the constant result of animal decomposition, its presence in recently manured soil, or even generally near the great resorts of man, may perhaps be readily conceded; but are we authorized to regard it as the source of nitrogen in plants, that grow in places remote from human habitation, where decaying animal matter cannot so constantly present itself?

This question, which had embarrassed all those who formerly indulged in speculations on the subject, seems at length to have been set at rest by the researches of Liebig.

"Experiments made," he says "in his Laboratory at Giessen, with the greatest care and exactness, have placed the presence of ammonia in rain-water beyond all doubt. It had hitherto escaped observation, merely because no one thought of searching for it." All the rain-water which he examined was collected 600 paces west of Giessen, whilst the wind was blowing towards the town in that direction. It could not therefore have been derived from any animal exhalations proceeding from that source. When several hundred pounds of this water were distilled in a copper still, and the first two or three pounds that came over had been evaporated with the addition of a little muriatic acid, very distinct crystals of sal-ammoniac were obtained.

Hence there can be no doubt, that ammonia must be constantly present, combined probably with carbonic acid, in the atmosphere we breathe, although in quantities too minute to be appreciable.

Its amount, as inferred from the indications afforded by the rain or snow-water that has been examined, appears to be very variable, being greater in summer than in winter, during long protracted drought than after a continuance of wet; but this is no more than might be expected when we reflect, that it must be principally derived from the decomposition proceeding in various parts of the globe of all kinds of animal exuviæ, the volatile products of which, until otherwise appropriated, will be retained in the general body of the atmosphere, as in a common reservoir.

> Semper enim quodcunque fluit de rebus, id omne
> Aeris in magnum fertur mare: qui nisi contra
> Corpora retribuat rebus, recreetque fluenteis,
> Omnia jam resoluta forent, et in Aera versa.

Thus ammonia will be constantly presented to the roots of plants in union with the rain-water that has descended from the heavens, even where the vegetable mould is so entirely destitute of animal matter as to be incapable itself of supplying it.

There is also another principle which may be called in, to explain the manner in which gaseous matters are brought into contact with the absorbing surfaces of plants.

It was originally shewn by Saussure, that charcoal has the property of absorbing and even condensing within its pores various gaseous matters, and Faraday observed, not many years ago, the singular facility with which earthy and metallic powders of all descriptions absorb ammonia, when present either in the air, or in the bodies with which they are brought into contact.

Reasoning upon these facts, I was myself led last spring to undertake a few experiments with the view of ascertaining, whether vegetable mould had not the same property, and I found accordingly that both carbonic acid and ammoniacal gases were condensed within its pores, as they would be within those of a lump of charcoal.

Liebig in his late volume has made the same remark, and has extended it to the oxides of iron, to pipe-clay, &c., and hence we have a mode of accounting for the absorption of ammonia by plants, even in countries, where the absence, or the rare occurrence, of rain might otherwise deprive them of a due supply of this necessary ingredient.

Nor are we any longer at a loss to trace the ammonia into the substance of the plant, which derives from it its nitrogen.

That it does actually find its way into the vegetable organization, we are assured by the researches of Professor Liebig, who ascertained, that the saccharine juice which flows from the different varieties of maple, even when growing in soils that were not manured, contains a large proportion of ammonia.

The same is the case with the juice extracted from beet-root for the purpose of preparing sugar, and the products of the distillation, of herbs, flowers, and roots with water, contain ammoniacal salts.

So also does the juice of the fresh tobacco leaf, and that which exudes from the vine, when an incision is made into it during the period that the sap is flowing.

Its occurrence in short in the juices of plants seems not less certain than its existence in the atmosphere, and there can be little doubt, that it is the decomposition of this compound which mainly supplies the nitrogen present in the constitution of organic bodies.

It may be inferred, however, from some experiments made by Boussingault, that a great difference exists between plants in their power of assimilating nitrogen, and to this difference that chemist is disposed to attribute the advantage of alternately growing what are called fallow crops, for the purpose of refreshing the soil.

"During germination," he remarks, "the quantity of azote which seeds contain appears to be on the increase, but there is this curious difference between different kinds, that whilst those of leguminous plants, sown in pure earth and moistened with nothing but distilled water, obtained an increase of nitrogen which the atmosphere alone could have afforded, those of barley and other cerealia remained in that respect stationary, unless manure were afforded."

Boussingault also shews in a subsequent memoir, that peas, clover, and other legumes absorb azote, even when planted in a soil that contains no decomposing animal or vegetable matter, but that the cerealia, although if so placed, they may grow, do not appear to secrete this principle.

Boussingault, however, does not go so far as to maintain, that the latter in no stage of their existence are capable of discharging this function, but only that the plant must have already arrived at a higher state of vigour, in order to derive its supply from such a source.

It is on the same principle, that although the animal in general obtains its food from the various organic bodies on which he subsists, yet that in an early stage of existence, before his organs are fitted for undergoing the labour of assimilating such materials, nature has provided him in his mother's milk with aliment already almost elaborated.

It is thus, too, that in the seed the embryo is surrounded with a mass of albumen, from which it derives its support, until its roots become sufficiently vigorous to extract nourishment from the ground.

Hence it becomes in most cases necessary, that crops cultivated as articles of food should have access to vegetable or animal manure from which they may derive their azote, but as this supply would soon be exhausted, were it not at the same time regenerated from the atmosphere, we see the advantage of intercalating a green fallow crop ploughed into the ground with others, as leguminous plants, according to the experiments of Boussingault, have the greatest power of absorbing nitrogen from the air.

On the same principle this chemist suggests the introduction of the Jerusalem artichoke into light soils, which, owing to the entire absence of mould, appear irreclaimably barren; this vegetable, the tubers of which afford nourishment to cattle almost equal to potatoes, having great power of absorbing both carbon and nitrogen from the air, and thus by degrees generating a certain amount of soil[r].

I have seen this vegetable very commonly cultivated for the use of cattle, in the light lands of the Grand Duchy of Baden and in certain parts of Alsace.

But if it be true, as Liebig has endeavoured to establish, that plants obtain every thing except their alkaline and earthy constituents from the atmosphere, what, it may be asked, becomes of the theory of which mention was made in the preceding lecture, that attributes the unfitness of a soil for yielding several successive crops of the same plant to the excretions given out by its roots?

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[r] It is to be observed, that Boussingaulta attributes to plants the power of absorbing nitrogen from the air, but he alleges no proof that they have that power, and his results may be just as well explained by supposing them to have different powers of absorbing ammonia. It is to be remarked, that the helianthus tuberosus belongs to a tribe of plants remarkable for their power of absorbing and exhaling water, and hence it is evident, that they will be brought into contact within a given time with a larger amount of ammonia, than other plants which possess a less degree of energy in that respect.

For if plants receive the whole of their volatilizable ingredients from the atmosphere, these excrementitious matters, being composed chiefly of carbon, hydrogen, and oxygen, will not be absorbed, and therefore cannot affect the succeeding vegetation.

The above inference would seem unavoidable, if it were considered absolutely proved, that nothing but the fixed ingredients of a plant were derived from the earth, but this is not fully established even with respect to the humus, much less with respect to the more soluble matters which the soil contains.

These latter, there seems no reason for doubting, may be taken up by the spongioles of the roots dissolved in water, together with the alkaline and earthy ingredients which are derived from the soil, nor am I aware of any proof that they may not likewise be assimilated when so introduced.

The theory of M. Decandolle, therefore, is not affected by the above experiments, but must rest on its own merits, and continue to afford a subject for inquiry to the scientific agriculturist.

And now, having laid before you, what is at present known with respect to the sources from which plants obtain their several constituents, I ought to proceed in the next place to those practical inferences which appear deducible from the above general considerations—the time, however, that has been already consumed in the previous discussions warns me, that this portion of the subject must be for the present deferred, and that the completion of my original design will afford abundant materials for another Lecture, in the series of those which, in compliance with the injunctions of the Founder of the Professorship of Rural Economy, I am called upon to deliver.

RURAL ECONOMY.

LECTURE III.

In my last Lecture, I endeavoured to put before you the principles upon which the farmer ought to proceed, in the employment of manures, and in the other operations, by which he attempts to ameliorate the condition of the soil; and with this view, I examined the origin of the various ingredients, whether solid, liquid, or gaseous, which ordinarily enter into the composition of vegetables.

But I shall have accomplished only a portion of my task, and that the one least interesting to the practical farmer, until I have pointed out in detail the applications of which the preceding principles appear to admit, and have shewn, in what manner our knowledge of the sources from whence plants derive their support, may assist to guide us in the ordinary operations of husbandry.

Now the first inference that may be drawn from the principles above laid down, relates to the utility of diligent and frequent tillage, in order to favour the disintegration of the soil, and the free admission to it of oxygen and of water.

Unless the former take place, no fresh alkali can be extracted from the subjacent rock by the action of water upon it; unless the latter be brought about in a sufficient degree, the humus excluded from air cannot undergo that process of eremacausis, or gradual combustion, on which its influence upon the nutrition of plants has already been shewn to depend.

Hence, in ancient times, the importance attached to those operations which had this object for their aim—

> Multum adeo, rastris glebas qui frangit inertes,
> Vimineasque trahit crates, juvat arva: neque illum
> Flava Ceres alto nequicquam spectat Olympo:
> Et qui, proscisso quæ suscitat æquore terga,
> Rursus in obliquum verso perrumpit aratro,
> Exercetque frequens tellurem, atque imperat arvis.

"Quid est agrum bene colere?" asks Cato. "Bene arare. Quid secundum? Arare. Quid tertium? Stercorare."

Thus ploughing was regarded the most important process in agriculture, after which, though at a long interval, came manuring.

The design therefore of the agriculturist is to reduce the soil to that loose and crumbling condition, in which it becomes entirely pervious to air and moisture, imparting to it the quality which the ancients denominated *putre*.

> Et cui putre solum, (namque hoc imitamur arando)
> Optima frumentis.

Hence the superiority of spade husbandry over the plough, if the expense of the labour be not taken into the account: hence the fertility of the small farms of the ancient Romans, notwithstanding their rude methods and their deficiency of skill: hence the fine condition of those tracts of land, which are subjected to the unremitting manual exertions of societies of men like the Trappists, whose mistaken views of religion have led them into that entire isolation from human society, under which even the severest physical toil becomes itself a relief.

The same principle explains in some degree the utility of subsoil ploughing, which, by bringing up to the surface a portion of earth previously out of the reach of those influences which tend to cause its disintegration, extracts from it the alkaline and other ingredients required by the plant for its subsistence.

It is found advantageous, in the first instance, merely to break and pulverize the subsoil to a depth of eighteen or twenty inches, without bringing it to the surface, and only after a lapse of four or five years to mix it with the vegetable mould above, a practice, the utility of which depends, not only on the mechanical condition of the land being rendered more favourable to culture in consequence of its becoming more friable, but likewise, probably, owing to the chemical decomposition of its component parts having taken place more completely.

Other circumstances, such as its influence on the drainage of the land, will no doubt co-operate in producing the benefit which often results from the practice of subsoiling; but that the cause pointed out really contributes to its efficacy, may be inferred from a fact attested by many experienced agriculturists[s], namely, that those soils are most benefitted by subsoil-ploughing, which can be rendered thereby more pervious to moisture, and consequently to air; whilst those which contain too large a per centage of clay to be affected in this manner by the process, derive no advantage from it.

But it must not be forgotten, that the utmost pains bestowed upon its elaboration cannot generate any new principles, but only act, by enabling the soil to impart more readily to the crop those which it already possesses.

This obvious truth will explain the cause of the disappointment felt by farmers, at finding, that after a certain time, the most diligent tillage no longer affords them the same returns as it did at first.

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[s] See English Agricultural Journal, No. 5, p. 32.

It is said, that Jethro Tull, who first proved the advantages of deepening and pulverizing soils, was nevertheless obliged at length to admit, that at each repetition of the experiment the success was less decided, unless manure were at the same time applied. Judicious tillage, in short, like the use of machinery in the arts, does not create any new power, but only tends to render more available those already latent in the earth.

It was not therefore without reason, that Cato, after, as we have seen, pronouncing, that the first, and the second thing in agriculture, is to *plough*, adds, that the third is to *manure*, for what is this, but the art of providing for the intended crop an adequate supply of those ingredients which enter into its composition?

The principles therefore which have been laid down, whilst they will serve to guide the husbandman in the selection of his fertilizers, may also explain the different results that are obtained from the use of the same kind of mineral manure in different soils.

Among those which have excited the greatest interest within the last few years, may be mentioned the nitrates, of potass, and of soda.

The former, commonly called saltpetre, is produced spontaneously in most parts of the world, and especially in hot countries, in consequence of animal and vegetable decomposition conducted under particular conditions, and accordingly it has been introduced into agriculture from an early period [s].

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[s] Where the price operates as an objection to its use, the method of forming artificial nitre-beds, by mixing together vegetable and animal matters in a state of decomposition with calcareous earth, may be economically adopted. See Cuthbert Johnson, on Saltpetre and Nitrate of Soda, Ridgway, 1840.

The latter, sometimes distinguished from its crystalline form, as cubic nitre, is met with in large quantities in Peru, fourteen leagues from the port of Iquicque, where, according to Mr. Darwin[t], it forms a stratum two or three feet thick, lying close beneath the surface, and following the margin of a grand basin or plain, elevated 3300 feet above the level of the Pacific, but which, nevertheless, appears evidently to have been at one time a lake, or inland sea.

The price of the salt at the ship's side in 1835, at the time Mr. Darwin visited the spot, was fourteen shillings a cwt., the grand item of expense being its transport to the coast.

These particulars are perhaps not unimportant, as they may serve to shew, that an almost unlimited supply of both these salts may be calculated upon, and, in the case of the nitrate of soda, that its price might be kept down, rather than enhanced, by an increased demand.

That, however, with which the agriculturist is most concerned, is to determine the relative value of these salts as manures, and to discriminate the kind of land to which either or both are beneficial.

Now, it is remarkable, that the nitrates, whilst they have in some cases occasioned a wonderful increase of produce, in others have appeared of little service, and also that, whereas on certain land both were equally efficacious, on a different description of soil, the one has answered, whilst the other failed.

For a great deal of interesting information on this subject, I may refer to the Journal of the Royal Agricultural Society of England—its last number[u] more especially : on the present occasion I shall confine myself to noticing the communication of Mr. Hyett, of Painswick, as one, which probably points to the true cause of the advantage derived from the employment of these salts.

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[t] See Darwin's Journal, in Voyage of the Beagle.

[u] For January, 1841.

Mr. Hyett's experiments were made upon the stone or corn-brash of Gloucestershire, a coarse and impure oolitic limestone, which had been drilled with white Sicilian wheat in the autumn.

Nitrate of soda, at the rate of 1 cwt. to the acre, was, on the 21st of April, sown and hoed in over all the field, excepting two square portions, which were staked out, and left unnitrated.

On the 16th of May the effect of the salt was perceived, by the dark green colour of the plants.

The results of the harvest were as follows:

	Measure per acre.		Value per acre.
Produce.	Without nitrate.	With nitrate.	Excess.
	Bu. Pks. Pts.	Bu. Pks. Pts.	Bu. Pks. Pts.
Corn clean	30. 2. 11	37. 3. 4	7. 0. 9
—— tail	2. 3. 11	5. 3. 7	2. 3. 12
—— total	33. 2. 6.	43. 2. 11	10. 0. 5
	Weight.	Per acre.	
	T. Cwt. qrs. lbs.	T. Cwt. qrs. lbs.	T. Cwt. qrs. lbs.
Straw	1. 3. 1. 21	1. 11. 2. 3.	0. 8. 0. 10

From these data Mr. Hyett calculates, that the increased value of the produce, arising from the use of the nitrate of soda, gives a profit of 2*l*. 17*s*. 2*d*. per acre, after deducting 1*l*. 3*s*. 0*d*. for the value of the salt employed.

But not only does the nitrate increase the quantity of the grain, but it tends to augment those ingredients, which contain the largest amount of nitrogen, and consequently afford the greatest degree of nutriment, namely, the gluten and albumen.

This is shewn, by the analysis of the nitrated, and non-nitrated wheat, made by a chemist at his request, the results of which were as follows:

	Wheat on which the nitrate was used, gave	Wheat on which no nitrate was used, gave
Bran	25.000	24.000
Gluten	23.250	19.000
Starch..........	49.500	55.500
Albumen	1.375	.625
Extract	·375	.250
Loss and water ..	·5	.628
	100. parts.	100. parts.

Thus it is seen, that in the nitrated wheat there was 4.25 per cent. more gluten, and 0.75 more albumen, than in the non-nitrated sample.

Considering then, that these constituents contain nearly 16 per cent. of nitrogen, we are justified perhaps in attributing their increase, to the decomposition of the nitric acid present in the salt, and the consequent supply of nitrogen in greater abundance than is naturally present in the soil.

And if such be the mode of its operation, it may be possible to explain why these salts should appear so capricious in their effects on the different kinds of land to which they have been applied.

When the ground already contains all the other constituents which the plant requires, as for instance, a sufficient amount of the earthy phosphates, and of silicate of potass, the addition of the nitric salt will do good, by supplying nitrogen, and thus enabling the vegetable to assimilate a proportionate quantity of the other ingredients.

But when the latter are already nearly exhausted, the addition of the nitrates will no longer be of advantage, since only that portion of nitrogen can be assimilated which is equivalent to the amount of the earthy phosphates, of the silicate of potass, and of the other fixed ingredients, which the plant obtains from the soil.

Hence, the proper remedy in such a case would seem to be, that of applying some other manure, which may furnish a due supply of the deficient matters.

Thus, if the nitrates have failed, we should be inclined to try the next year the effect of phosphate of lime, or of animal manure, upon the same soil.

But it seems to happen sometimes, that the same land, which is benefited by the administration of one kind of nitric salt, is scarcely affected by another.

This anomaly presented itself in an experiment on a small scale, which was tried at my request, by my brother, the Rev. E. Daubeny, on his farm, in the vicinity of Cirencester.

The subsoil is a stiff retentive clay, resting upon the corn-brash limestone, and the farm, before it came into its present occupation, was in an exhausted condition, though it has latterly yielded somewhat better returns.

A coarse analysis of a sample, conducted according to the method recommended by Mr. Rham, in the Journal of the English Agricultural Society[x], afforded me the following results:

1000 grains contained, 607 of impalpable powder, consisting of

Water	57
Humus	57
Silica	64
Alumina mixed in the Silica	24
Oxide of iron	19
Carbonate of lime	90
Magnesia	a trace
Clay	296
Total	607

And 388 of coarser materials, separated by

Sieve	No. 1.	the coarsest	117	Consisting chiefly of clay, with 50 grs. of carbonate of lime.
Sieve	No. 2.		151	
Sieve	No. 3.	the finest	120	
Total			388	
Loss			5	

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[x] Number 1, page 46.

Four equal strips of this land, each somewhat exceeding ¼ of an acre, and contiguous one to the other, which had been sown with wheat in the autumn of 1839, were measured out.

The first of these, which lay next to the hedge, was left without any addition of manure.

The second, adjoining, had a top-dressing of ¼ cwt. of nitrate of potass given it in April.

The third portion was left, like the first, without addition.

The fourth, or that farthest from the hedge, had a similar top-dressing of nitrate of soda applied at the same period.

The salts were respectively scattered over the strips of land in as uniform a manner as possible, and became diffused through the soil, by means of the showers which followed shortly after their application.

As the wheat advanced towards maturity, the nitrated patches were distinguishable, by the more vivid greenness of the crop, and by its standing up somewhat above the general level, but this difference was less perceptible at a later stage of its progress.

In the autumn the whole was reaped as usual, and the following results obtained:

No. 1. produced only 5 bushels, 54 lbs. of grain, or 23 bushels, 36 lbs. to the acre, but the crop had been accidentally trodden by sheep, and much devoured by birds. The straw was not weighed.

No. 2. produced 7 bushels, 57lbs., or 31 bushels, 48lbs. to the acre, and 520lbs. of straw = 1 ton, 0 cwt, 80lbs. to the acre.

No. 3. produced 6 bushels, 54lbs., or 27 bushels, 36lbs. to the acre, and 421lbs. of straw = 16cwt. to the acre.

No. 4. produced 6 bushels, 48lbs., or 27 bushels, 12lbs. to the acre, and 432lbs. of straw = 15cwt. 48lbs. to the acre.

With respect to weight, that of No. 2. was 62½lbs. to the bushel, that of No. 3. and 4. was only 62lbs.

Now 3½lbs. of flour from No 3, produced of bread 4lbs. 4ozs.

Whereas 3½lbs. from No. 2. produced 4lbs. 14ozs.

Hence the difference, between the produce of the strip of ground which had been manured with nitrate of potass, and that which had received no manure, may be calculated as follows:

Amount of produce, of

	Bu.	lbs.		
No. 3.	6	54	=	6.
No. 2.	7	57	=	7.

As 6 : 7 : : 100 : 120, or 20 per cent. of increase in the amount of produce.

To which add, that the quantity of flour, that in No. 3. had produced 4lbs. 4ozs. of bread, in No. 2. produced 4lbs. 14ozs. Now

As 4lbs. 4ozs. : 4lbs. 14ozs. : : 100 : 114.

Shewing an increase per cent. of 14 + 20 = 34 per cent.

Now if we calculate the wheat as worth eight shillings a bushel, the profit of using the nitrate of potass will stand as follows:

27 bushels 36lbs. at 8*s.* = 11*l.* value of the produce on the non-nitrated land: add 34 per cent. or ⅓rd = 3*l.* 13*s.* 4*d.*, for the value of the nitrated, which, after deducting 1*l.* 10*s.* for the value of a cwt. of nitrate of potass, and for carriage, will leave to the farmer a clear profit of 2*l.* 3*s.* 4*d.*

The superior absorbing power of the *nitrated* flour, over the *non-nitrated*, was found to depend upon the presence of a larger amount of gluten, for I discovered in the former 740grs. in the pound, or 13 per cent.; in the latter 850grs. in the pound, or 15 per cent. of that ingredient, the difference being 2 per cent. in favour of the nitrated wheat, a result which confirms, in a very satisfactory manner, the statement of Mr. Hyett[r].

But how are we to account for the failure of the nitrate of soda, on soil which had been so materially benefited by the administration of nitrate of potass?

The small scale upon which the experiment was conducted, may render us reluctant to build much upon the results obtained, until it has been again repeated, but, supposing the fact to be hereafter confirmed, I can only conjecture, that the difference must have arisen from a deficiency in the land, of potass, which would be supplied by the saltpetre, but not by the nitrate of soda[s]. Should this be the true solution, those soils, in which nitrate of soda has succeeded, ought to contain a larger quantity of potass, than those in which it has failed.

The general principles laid down may also inform us, as to the true plan upon which the succession of our crops should be regulated.

Those plants ought to succeed each other, which contain different chemical ingredients, so that the quantities of each, which the soil at any given time contains, may be absorbed in an equal ratio.

Thus a productive crop of corn could not be obtained, without the phosphates of lime and magnesia which are present in the grain, nor without the silicate of potass which gives stability to the stalks.

It would be injudicious, therefore, to sow any plant that required much of any of the above ingredients, immediately after having diminished the amount of them present in the soil, by a crop of wheat, or of any other kind of corn.

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[r] The amount of gluten is smaller than in the samples reported on by Mr. Hyett, but my gluten was dried, with the greatest care, under the exhausted receiver of an air-pump, with sulphuric acid, till it ceased to lose weight.

[s] Nitrate of soda is stated to exist in barley, but it has not been detected in wheat. It would therefore be worth while to see, whether the above salt is particularly suited to the former crop.

But, on the other hand, leguminous plants, such as beans, are well calculated to succeed to crops of corn, because they contain no free alkalies, and less than one per cent. of the phosphates.

They thrive therefore, even where these ingredients have been withdrawn, and during their growth, afford time for the ground to obtain a fresh supply of them, by a further disintegration of the subjacent rock.

For the same reason, wheat and tobacco may sometimes be reared in succession in a soil rich in potass, because the latter plant requires none of those phosphoric salts which are present in wheat.

In order however to proceed upon certain data, it would be requisite, that an analysis of the plants most useful to man should be accomplished in the different stages of their growth, a labour which has hitherto been only partially undertaken, and which perhaps is an object worthy to engage the attention of a great Body, like that of the English Agricultural Association.

It is a curious fact, that the same plant differs in constitution when grown in different climates. Thus in the beet-root, nitre takes the place of sugar, when this plant is cultivated in the warmer parts of France[t].

The explanation of this difference is probably as follows :—

Beet-root contains, as an essential ingredient, not only saccharine matter, but also nitrogen, and it is probable, that the two are mutually so connected together in the vegetable tissue, that the one cannot exist without the other. The nitrogen, being derived from the decomposition of ammonia, must be affected by any cause which diminishes the supply of the latter, and in proportion as this ingredient is wanting, the secretion of sugar will likewise fall off.

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[t] See Chaptal.

Now, it has been shewn by Liebig, that the formation of nitric acid is owing to the decomposition of ammonia, and it is conceived by him, that the last products of the decomposition of animal bodies present themselves, in the form of ammonia in cold, and in that of nitric acid in warm climates[n]. Hence, in proportion to the amount of nitric acid formed, and of nitre absorbed by the plant, that of the nitrogen, and consequently that of the saccharine matter, present in it, may be diminished.

We may also be guided in the management and selection of manures, by the principles above laid down.

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[n] I have seen no attempt to account for the formation of nitrate of soda in such large quantities in Peru, and may therefore offer the following, as at least a plausible solution.

Wherever salt lakes occur, which become partially or wholly dried up during a part of the year, carbonate of soda will be formed from the decomposition of common salt. This I have observed myself on the sandy plains of Hungary, in the neighbourhood of Pesth. Now if any circumstances should concur in such spots, calculated to generate nitric acid, the latter, by its stronger affinity for the alkali, would take the place of the carbonic acid, and nitrate of soda would result.

This, however, being a deliquescent salt, would not accumulate on the surface, except in countries like Peru, remarkable for their extreme dryness.

But how are we to account for the generation of so large a quantity of nitric acid in this locality?

If we suppose with Mr. Darwin, that the district in which the salt is found was once a lake or inland sea, its change to dry land must have caused the destruction of all its marine inhabitants. Now the decomposition of their exuviæ would, in a warm climate, present themselves, as stated in the text, in the form, rather of nitric acid, than of ammonia.

Hence the production of so much nitrate of soda in Peru, is attributable to the *heat;* its preservation, to the *dryness* of the climate.

The solid excrement of animals varies of course in composition according to the nature of their food: thus that of herbivorous animals, which are fed principally on grasses, contains much silicate of potass, as well as phosphoric salts, but comparatively little nitrogen; whilst human fæces contain little of the former ingredient, but much phosphate, and a larger proportion of nitrogen. There will be seen even a difference in these respects between the manure afforded by the inhabitants of towns, fed principally upon animal food, and by that of peasants, who subsist in a greater degree upon vegetables.

In like manner, the excrement of cattle is more efficacious as manure, when the animal is well fed, and undergoing the fatting process, than when it is more scantily nourished.

According to Sprengel, there is a difference between different kinds of herbivorous animals in this respect, cows requiring, for the chemical constitution of their body, or for the formation of their milk, more nitrogen, and more phosphate of lime, than sheep; whilst the latter require again more sulphur, and more common salt, for the formation of their wool. Hence the excrements of oxen contain less nitrogen than those of sheep, whilst they are more abundant in salt and sulphur.

Accordingly it is found in practice, that sheep's dung ferments more readily than that of black cattle. "The latter therefore," says Liebig, "is of most service on soils consisting of lime and sand, which contain no silicate of potass or phosphates, whilst their value is much less when applied to soils formed of argillaceous earth, basalt, granite, porphyry, clinkstone, and even mountain limestone, because all these contain potass in considerable quantity."

Human excrements, on the contrary, are useful in both descriptions of soil, but would be inadequate to supply the silicate of potass which is wanting in the former.

The constituents, however, to which the solid excrements of animals in general owe their principal efficacy are the earthy phosphates, and hence we see, why it is that animal manure should favour the growth of corn, which contains so much phosphate of lime and magnesia, and why the earth of bones, and even the ashes of certain kinds of wood, such as the beech, which contain phosphates, may be advantageously substituted, whilst the ashes of others, as of the oak and fir, which are deficient in the phosphates, are of very little avail. According to Liebig, every 100 lbs. of the lixiviated ashes of the beech, spread over the soil, yield as much phosphate as 400 lbs. of fresh human excrement, and will be sufficient to supply a field with phosphoric acid enough, for the production of 3820lbs. of straw, or for 15 to 18,000lbs. of corn.

We see also the cause of the fertilizing quality of liquid manure, as employed in Holland, for those crops which are most subservient to the nourishment of man.

Liquid manure consists in a great degree of the urine of various animals, which, during its decomposition, exhales a larger quantity of ammonia than any other species of excrement.

Now all kinds of corn contain nitrogen, and consequently any manure which yields a ready supply of ammonia, must cause a fuller development of those parts of the plant which are of the greatest use to man.

Even the kind of animal manure usually employed in this country owes its efficacy, so far as it is dependent upon the ammonia present, to the urine, rather than to the solid excrement, of which it is made up, and hence becomes materially deteriorated in this respect, when the more liquid portions are allowed to drain off from it.

We may also derive from these considerations, some useful cautions, as to the treatment of this same material.

Ammonia, in the free or uncombined condition in which it is generated from the decomposition of animal substances, is caustic and noxious to vegetation, and is likewise so volatile that it will escape into the atmosphere so soon as it is produced, unless some means are taken to detain it.

This causticity is readily removed by promoting its combination with the carbonic acid of the atmosphere, but to prevent its escape during the time necessary for effecting this union, various expedients have been resorted to.

Where water in sufficient quantity is present, along with the other materials of the dung heap, this alone will in some measure tend to prevent its volatilization, and the same object is further secured, by admixture with peat, as recommended by Lord Meadowbank, or with sawdust, tanner's bark, turf, and other similar substances. These too are beneficial, not only by moderating the putrefactive process, but also by detaining the ammonia generated within their pores, and thus preventing its loss.

The advantage of compost heaps, which are strongly advocated by some farmers, depends mainly on these principles.

The method recommended by a writer, in a late number of the English Agricultural Journal[i], to whom a prize of ten sovereigns was awarded for his Essay, consisted, in first making a substratum of peat ¾ths, and sawdust ¼th; spreading over it the dung from the cattle-sheds, and the urine preserved for the purpose in tanks contiguous; and then, after allowing the mixture to remain exposed for a week, covering it with a fresh layer, nine inches or a foot thick, of peat and sawdust, or of peat alone.

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[i] Part ii. p. 135.

Several such alternations of peat and manure are to be piled one above the other during the winter, great care being always taken, that the peat should be as dry as possible, by exposing it previously for several months to the weather.

Now it will be immediately perceived, that these recommendations of a practical farmer completely fulfil the conditions, which theory suggests, for making the best use of our manure, by first neutralizing the ammonia, and afterwards detaining it within the pores of a spongy substance, until it is spread over the land.

The most effectual plan, however, of preventing its loss, would seem to be, not to wait for the slower action of carbonic acid upon it, but to combine it directly with those acids, which form with it salts fixed at common temperatures.

Hence, Liebig advises the addition of sulphuric or of muriatic acid, both cheap substances, to the other materials of the dung-heap, which, forming with the ammonia present, the sulphates and muriates of that alkali, would at once prevent any loss of it by evaporation.

If these expedients be not adopted, it should at least be borne in mind, that unless means are taken to prevent it, the most valuable portion of the manure is constantly escaping, during exposure to air and sun, by evaporation, and also by draining off into the ground, whence, instead of a material calculated to afford a ready supply of nitrogen to the plant, we obtain an *effete* mass, in which that element is in a great measure wanting, and which therefore can only influence the growth of plants, by virtue of the phosphoric salts and other fixed ingredients still present in it.

These views also throw some new light upon the use of gypsum, or sulphate of lime, as a manure to certain crops.

The fact, that leguminous plants contain this substance as an essential ingredient, may in some measure explain its fertilizing effect on them, but it is also found serviceable to turnips and cabbages, which do not appear to contain it, nor does it seem easy thus to explain the superior advantage said to arise, from scattering it in fine powder over the leaves of clover and saintfoin, as is practised in France and in North-America, and with such manifest good effect, that, it is said, if the substance be partially applied to a field, the portions that have received this dressing may afterwards be distinguished from the rest by the superior luxuriance of the crop.

Liebig, therefore, has suggested another mode in which gypsum may be beneficial to crops in general, by reference to the property which it possesses, of depriving ammonia of its volatility, and thus preventing its escape into the atmosphere.

This effect arises from the double decomposition which takes place, when sulphate of lime and carbonate of ammonia are brought together, the lime being converted into a carbonate, and the ammonia uniting with sulphuric acid.

The above theory of its use being admitted, we may be encouraged to extend its application to other crops besides the Leguminosæ, and also to mix it with the dung of our stables, so as to prevent the waste of this valuable material, which is constantly occurring.

Liebig calculates, that every pound of ammonia which evaporates is equivalent to a loss of 60 lbs. of corn, and that every pint of urine would produce a pound of wheat. Hence it is evident, how much waste must accrue from the negligent manner in which the animal manure of our stables is preserved.

But the farmer must be reminded, that in either case, it will be necessary, that the sulphate of ammonia resulting from the action of the gypsum, should be brought into contact with some substance capable of slowly decomposing it, so as to supply ammonia to the plant.

For there is no reason to believe, that the organs of a vegetable can decompose sulphate of ammonia, and if they were able so to do, the disengagement of free sulphuric acid in consequence could hardly fail to be injurious to their structure.

Now a soil consisting of pure sand, or of clay, would be incapable of acting upon this salt, but contradictory as it may seem to the fact, that carbonate of ammonia is decomposed by sulphate of lime, carbonate of lime does appear in a slight degree to disengage ammonia even in the cold, as may be seen by the change of colour produced in a piece of turmeric or reddened litmus paper, placed over a vessel containing powdered chalk, as soon as it is moistened with a solution of sulphate of ammonia.

And since this interchange of constituents is effected rapidly under the influence of a high temperature, as happens in the common method of obtaining carbonate of ammonia artificially by double decomposition, it is worth inquiry, whether it may not be favoured likewise by exposure to solar heat and light.

Where calcareous matter therefore exists in the soil, ammonia may be slowly supplied in this manner to the growing plant, and it is possible even, that the carbonate of lime, which seems to be generally present in the sap, may act in the same manner.

In this way we may readily explain the use of scattering gypsum over the leaves of clover shortly before a shower of rain. The ammonia present in the latter is thus detained, and converted into sulphate by the action of the gypsum upon it, and when introduced into the system by the absorbing surfaces of the plant, it may be again converted into carbonate, by the slow action of the carbonate of lime present in the sap.

When, however, a more rapid disengagement of ammoniacal gas is required for the nutrition of the intended crop, we ought not to trust to the slow action of carbonate of lime, but should apply quick-lime to the spots over which the manure has been scattered.

It is probably in part by setting at liberty the volatile alkali imprisoned in the soil, that quick-lime acts so beneficially in agriculture, and in particular, that it improves soil containing a free acid, such as peat earth, for, independently of its use in neutralizing a substance, which checks vegetation by its antiseptic properties, quick-lime may also disengage a portion of ammonia combined with this acid, and thus afford to the plant a more abundant supply of the nitrogen, which it requires.

Chloride of calcium, common salt, sulphuric and muriatic acids, phosphate of lime, and other salts, may, it would seem, on the principles laid down, be substituted, when gypsum cannot be obtained.

The chlorides indeed, like certain oxides, (such as water and carbonic acid,) seem to be decomposed by the plant under the influence of light, for chlorine is exhaled by vegetables near the sea, as oxygen is in other situations. Hence, if muriate of ammonia should result from the action of common salt upon the carbonate of ammonia present in rain, it may undergo decomposition when absorbed by the plant, and contribute in consequence to supply it with nitrogen.

The above considerations may suggest to us the utility in agriculture of ammoniacal compounds of all kinds, as substitutes for animal manure.

Sal ammoniac is probably too expensive an article to be employed; but sulphate of ammonia may be had of the wholesale chemist at a price considerably more reasonable, namely, at 22*l.* per ton; and the ammoniacal liquor, which is afforded in abundance by our gas manufactures, through the distillation of coal, is a still cheaper commodity.

The latter consists principally of carbonate of ammonia, mixed with a certain proportion of the hydro-sulphuret, and, until its use in agriculture was discovered, much of it was allowed to run waste into the Thames, where its noxious qualities destroyed the fish, and rendered the water unpalatable and disgusting.

Its efficacy as a manure is vouched for by many who have made trial of it upon their land[k], and although the hydro-sulphuret of ammonia in a concentrated form would doubtless be fatal to vegetation, yet in a proper state of dilution it may be of service to certain crops, not merely by virtue of the ammonia, but also in consequence of the sulphuretted hydrogen, which it contains, since the latter is found to be an ingredient in the turnip, and in some other tribes of cruciferous plants.

Where, however, it is found troublesome to preserve, or difficult to convey to a distance this volatile material, an easy method presents itself for retaining for any length of time the ammonia present in it.

This is done, by availing ourselves of the same principle which has been already explained to you, in treating of the uses of gypsum as a manure, for as the gas liquor consists of ammonia, combined principally with carbonic acid, it is evident, that it may be converted into a sulphate[k] by admixture with sulphate of lime.

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[k] See a communication by Mr. Paynter, on Gas-water as a Manure, Eng. Agricult. Journ. No. 1. p. 4.

I am indebted to an excellent scientific chemist[l] for the following details, which may be of use to the agriculturist in enabling him to appreciate the importance of this commodity, and to prepare for himself any quantity that he may require for his farm.

One gallon of the ammoniacal liquor added to 1lb. 2½ozs. of powdered, but not calcined gypsum, will produce 1lb. of crystallized sulphate of ammonia. To effect the decomposition, the materials should be mixed and stirred up together for ten or twelve hours, a heat, below that of ebullition, being at the same time employed. The sulphate of ammonia remains in solution, and may be obtained in a solid state, by evaporating at a low temperature.

Theory would suggest, that this material ought to supply nitrogen to the crop at a much cheaper rate than the nitrates employed for that purpose. For let us suppose, that the farmer wishes to add to his land 60lbs. of crystallized sulphate of ammonia. This may be obtained by introducing about 70lbs.

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[k] A curious instance of molecular attraction was pointed out to me by Dr. Buckland, with regard to this substance, which, after standing for twenty-four hours in a closed bottle, changed from a grey to a black colour. The blackness I found to arise from particles of carbon disseminated through the crystalline mass, which, owing, as it would appear, to their more minute state of division, had at first produced no influence upon the colour of the salt, until they had had time to collect into clusters; thus affording one instance amongst many, of a motion taking place amongst the particles of a body, after it had assumed a solid state.

[l] Mr. Richard Phillips, the superintendent of the chemical department of the establishment, connected with the Museum of Economic Geology, lately instituted by government.

of powdered gypsum uncalcined into 50 gallons of ammoniacal liquor; for my informant found, that 1 gallon mixed with chloride of calcium yielded 4800grs. of carbonate of lime, equivalent to about 7200grs. of crystallized sulphate of ammonia, or 1lb. 3ozs. Now 4800grs. of carbonate of lime are equivalent to 8250grs., or to 1lb. 5ozs. of sulphate of lime, with 2 atoms of water.

This, therefore, is the quantity of gypsum required, to convert the contents of 1 gallon of gas liquor into sulphate of ammonia, and accordingly, 50 gallons will require 70lbs. of gypsum, and will produce about 60lbs. of the ammoniacal sulphate.

Now since the price per ton of gypsum is from 2*l.* to 3*l.*, the cost of 70lbs. of it cannot exceed 2*s.*, and the labour of mixing the materials may be reckoned at about as much more; so that to a gas company, where this liquor, not being employed for manufacturing any of the salts of ammonia, has hitherto been regarded as so much refuse, and where the heat requisite for evaporating and crystallizing the product can be obtained with scarcely any increased expenditure, the cost of the impure sulphate would not exceed one penny per pound.

This then is less than half the cost of an equal quantity of nitrate of soda, which at its present price (23*s.* per cwt.) may be reckoned at two-pence-halfpenny a pound, and yet it may be shewn, that a given weight of sulphate of ammonia contains more ammonia, and consequently ought to yield more nitrogen, than nitrate of soda[m].

Sulphate of ammonia 75pts. contain of ammonia 17 = nitrogen 14.
whilst
Nitrate of soda ... 86pts. .... 17 = ... 14.

So far as theory goes, therefore the balance would seem to be in favour of the efficiency of sulphate of ammonia over nitrate of soda, in the proportion of 75 to 86.

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[m] Nitrate of potass ought to contain ten per cent. less nitric acid than nitrate of soda, but, as it is a less deliquescent salt, the difference between the two, as obtained in commerce, is not very considerable.

These considerations are merely offered, by way of encouragement to those who may be disposed to make trial of this promising kind of manure, and of course will go for little until they have been tested by experiment.

There are other materials also employed as manure, which appear to owe their efficacy to the presence of ammonia—such for example, as soot, which contains a considerable proportion of this principle united with carbonic acid, and which accordingly has for a long time been advantageously employed as a top-dressing to land.

Lastly, the foregoing considerations point out the decided superiority of human to other sorts of animal manure.

Independently of its being richer in most of those ingredients on which the fertilizing property of manure depends, the following circumstance gives it an advantage.

When the excrements of the horse or ox are employed, we are obliged to allow of their undergoing a long previous process of fermentation, by which a large proportion of their valuable matter is got rid of, in order as much as possible, to destroy the vitality of the seeds, which pass undigested along with the fæces. And after all many still remain, and are thus introduced into the fields when the manure is scattered over them.

By the use of night-soil we avoid this inconvenience, and hence it is, that in China, where it is exclusively employed, the corn-fields are remarkably exempt from weeds.

Chemistry has suggested means for destroying those offensive qualities which have hitherto limited the use of this species of manure, although it is stated by Liebig, that the method adopted for that purpose on the Continent is defective, inasmuch as a large proportion of their ammoniacal contents is allowed to escape.

Even under its present management, however, the process may be regarded as one of the most important presents which chemistry has yet made to the practical farmer, by rendering the accumulated filth of a large capital available for his purposes, in the remotest corner of the British empire.

Having now brought before you those practical inferences, which seem to flow naturally from the principles above laid down, or which were suggested by the distinguished chemist himself, to whom we are indebted for many of the leading doctrines, which it has been my purpose, in the preceding part of this lecture, to inculcate—it may seem that my task is concluded; for if I have succeeded in tracing all the volatilizable constituents of the vegetable kingdom directly to the atmosphere, it may appear to some of you a subject of idle curiosity to push our inquiries farther.

Nevertheless, I cannot refrain from calling your attention to the fact, that carbonic acid and ammonia, which have been shewn to be the sources respectively of the carbon and the nitrogen of plants, on the one hand exist in such variable proportions in the atmosphere, that they may appear, from this circumstance alone, to be extraneous to its composition; and, on the other, are both seen to proceed, even at the present day, from the interior of the earth, in various parts of the globe.

Every one, who has made the phænomena of volcanos the subject of his attention, is conversant with the fact, that volumes of carbonic acid are constantly issuing from the earth, not only in places where igneous action manifests itself, but also wherever we have reason to believe that it has formerly existed, though apparently in a dormant condition at present.

Those too, who have visited any active volcano, must needs have remarked, that sal ammoniac is sublimed in large quantities, from the substance of lava-currents recently ejected, and likewise from the crevices of mountains in which the eruptions have taken place[m].

Professor Liebig has also pointed out, that ammonia is a constant accompaniment of the boracic acid disengaged by volcanic action from the Lagoons in Tuscany, and it is satisfactory to me to find that distinguished chemist confirming, by his authority, the view which I had long ago held and maintained, namely, that the ammonia in these cases cannot by possibility be derived from the decomposition of organic matter, since no beings could live at such a temperature, as that indicated by the steam which holds it in solution.

Hence, like the carbonic acid, ammonia must have been derived from certain processes taking place in the interior of the globe[n], processes, which may have preceded the existence of living beings, and which may have fulfilled some important office in the economy of nature, subservient to their existence and production.

Startling, indeed, as the position may appear, yet, being backed by the authority of Liebig, I shall no longer scruple to suggest as a matter at least of probable conjecture, that every particle of carbon, as well as of nitrogen, which enters into the constitution of the plants and animals, either now existing, or which have existed since the beginning of time, may have been originally evolved from the interior of the globe.

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[m] See my Memoir on the Eruption of Vesuvius in 1834, published in the Philosophical Transactions for 1835.

[n] Liebig, p. 112.

The only mode that suggests itself, by which we can escape from this conclusion, consists in supposing, 1st, that when it first pleased the Almighty to call plants into existence, He at once overspread the globe with them, without availing himself of the operation of secondary causes to bring about their dissemination; 2ndly, that the amount of carbon and of nitrogen contained in the plants created, sufficed for supplying the entire animal kingdom, in proportion as it extended itself, with the organic matter which it would require; 3rdly, that no increase to the collective amount of the animal, and of the vegetable matter in existence, has taken place, from the first period at which they were called into being, up to the present time.

Unless all these three postulates be assumed, it seems difficult, not to attribute to gases evolved from inorganic sources, the first origin of those organic matters, of which both plants and animals consist.

Now it will perhaps appear to some of my hearers futile, and even almost presumptuous, to go back, as it were, to the dawn of creation, and to speculate on events, that may have occurred at the first commencement of organic life.

Nevertheless, I may be permitted to observe thus much, namely, that analogy seems to favour the supposition, of each species of plant having been originally formed in one particular locality[c], from whence it spread

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[b] Mr. Lyell proposes the following hypothesis, as being reconcilable with known facts, viz. "that each species may have had its

itself gradually over a certain area, rather than that the earth was at once, by the fiat of the Almighty, covered with vegetation in the manner we at present behold it.

The human race, as we are informed by the highest authority, is descended from a single pair, and the distribution of plants and animals, over a certain definite area, would seem to imply, that the same was the general law.

Analogy would also lead us to suspect, that the extension of species over the earth originally took place on the same plan on which it is conducted at present, when a new island starts up in the midst of the ocean, produced either by a coral reef or by volcanic elevation. In these cases, we do not find the whole surface at once overspread with plants, but we can trace the gradual progress of vegetation, from the chance introduction, of a single seed perhaps, of each species, floated to it by currents, or wafted by winds.

Nor, indeed, does it seem probable, that a preternatural cause should have operated in covering the earth with plants, when natural ones are supposed to have been instrumental in the formation of the strata upon which they grew.

Since these latter have been built up gradually, through the successive accumulation of mineral and organic deposits, in which act Omnipotence did not directly interpose, we should be disposed to refer the full development of the former to a slow dissemination of individuals, in conformity with natural laws,

origin in a single pair or individual, where an individual was sufficient, and that species may have been created in succession, at such times and in such places, as to enable them to multiply and endure for an appointed period, and occupy an appointed space on the globe." Principles of Geology, vol. ii. chap. 8.

and to ascribe to the immediate hand of the Deity only the first introduction of each species.

Such an exertion of creative power, as is implied by suddenly calling into existence all the plants of a particular period, seems the more improbable, when we recollect, that it must have been repeated, at several successive epochs, since we cannot suppose, that the whole globe would have been in an equally forward condition, so as to be ready at the same moment for the reception of a redundant vegetation.

If, however, we were to grant, that the whole of the primary vegetation of the globe had started into being at once, so soon as the conditions of the earth's surface admitted, we should be bound to suppose the character of the plants analogous, rather to those existing in countries not yet brought under the dominion of man, than to those of cultivated districts.

Now, it is to be remarked, that the plants most useful to the higher classes of animals, inasmuch as they afford the greatest abundance of nourishment, are comparatively rare in a wild condition, and, when they occur, are generally deficient in those principles, on which their value as articles of food depends.

The forests, which under such circumstances cover so large a portion of the surface, contain but a small amount of nitrogen, for woody fibre, which constitutes the greater part of their bulk, is wholly destitute of that principle.

The cruciferæ, the different species of cereal grasses, and other plants rich in nitrogen, require for their full development animal manure, and therefore, if they had come into being at all at this early period, must have been stunted in their growth, and limited in their distribution.

Hence, it may be fairly doubted, whether the whole amount of the plants, which existed at one time on the surface of the globe, would have furnished azote enough for the animals of any given period.

Thirdly, it seems reasonable to suppose, that civilization has, upon the whole, increased the aggregate of animal life, as well as that of such vegetables as contain the largest quantity of nutritious matter.

I am aware, how difficult it would be to establish this last position in a manner perfectly unexceptionable, because the progress of human society is attended by a corresponding diminution in the amount of those animals, and of those plants, which are not dependant on man, and it seems impossible to strike a correct balance between the effects attributable to these two counteracting causes.

Nevertheless, the following considerations may perhaps be allowed to favour the opinion which I have been advocating.

There can be little doubt, that within the area embraced by culture, the amount of nutritious matter goes on increasing with the care bestowed upon the land, and that the number of animals maintained is in consequence proportionably increased.

This will be the case on a well-managed farm, even where (being situated at a distance from a town) it consumes no more manure than is obtained on the premises. At the end of a century, the live-stock may be increased, the crops may be more abundant than they were at the beginning, and yet every year a large quantity of carbon and nitrogen will have been carried off, in the shape of the corn and cattle sold.

Whence does this excess of carbon and of nitrogen then proceed? If from the decomposition of animals and vegetables extraneous to the farm, other portions of the globe must suffer in proportion to what is gained by those in cultivation, and hence the vegetation, as well as the amount of animal life, in regions which continue in a state of nature, will decrease, in proportion to the increase of those brought under subjection to man.

But we have not the slightest reason to imagine such to be the case, nor is there any ground for believing, that plants in a wild condition are unable to compete with cultivated ones, in the power of supplying themselves with those principles which are necessary for their existence; although it be true, that man, by selecting for culture such as afford him the greatest amount of nutriment, causes more nitrogen to be abstracted from the air, than would otherwise happen.

But what appears to me the most decisive objection yet remains to be stated.

Once grant with Liebig, that the nitrogen, which plants possess, can only be obtained by them through the decomposition of ammonia, and it will follow, that unless this gas be supplied from the interior of the globe, the quantity of organic matter, into which this principle enters as a component part, will be undergoing a continual diminution.

For we know of no natural processes taking place on the surface of the globe, which generate ammonia, excepting those connected with animal and vegetable decomposition; whilst there are many, such as the combustion of various organic substances, which, by resolving bodies containing nitrogen into their constituent elements, would have diminished the aggregate amount of them which might have formerly existed.

Some compensating process therefore is clearly required, and that, if I mistake not, is the disengagement of ammoniacal gas from the interior of the globe.

Possibly, however, it may be suggested as another alternative, that the quantity of these two gases, which would be required for the subsistence of the whole vegetable, and the whole animal kingdom, when first called into being, and likewise all that which might be necessary to supply the loss of ammonia occasioned by combustion, &c., through all succeeding ages, might have been ready prepared in the atmosphere, prior to their creation.

But, independently of the difficulty of conceiving, in the case of ammonia, by what means the particles of hydrogen and of nitrogen could have been brought to combine on the surface of the globe, without having been previously deprived of their elastic condition, those who propound this hypothesis, ought to be prepared to shew, that an atmosphere, charged with the gases in question, to the extent which is assumed, would not have been fatal to beings possessing an organization analogous to that of the existing races.

To confine ourselves to ammonia, Drs. Turner and Christison have shewn, that less than $\frac{1}{100}$th part of this gas, introduced into air, caused, in ten hours, a shrivelling and drooping of the leaves of a plant, and its subsequent death.

It may be doubted, therefore, whether even $\frac{1}{1000}$th part would not be too powerful a dose for the continuance of the healthy functions of the vegetable world, if permanently present, considering, that the juices of the plant, and the moisture of the earth in which it grows, would be continually drawing from the atmosphere, a constituent so soluble in water, and thus presenting it in a state of much greater concentration.

What the amount of nitrogen existing in all the plants and animals, either living or preserved from decay, throughout the globe may be, it would be extremely difficult to determine; but admitting Liebig's principles, it will follow, that the amount of ammonia actually existing in the air, will represent the average quantity, which at each moment of time is disengaged from the organic matter of all kinds undergoing decomposition.

The quantity of ammonia present in the atmosphere, under existing circumstances, will, therefore, bear the same ratio, to that required for the maintenance of the whole animal and vegetable creation together taken, as the amount of organic matter, at any given time undergoing decomposition, does to that in a state of life, or of preservation from decay.

Now, it may be collected, I think, from Liebig's statements, that a pound of rain-water sometimes contains as much as $\frac{1}{4}$th of a grain of ammonia, or about $\frac{1}{30000}$th part. Could we tell therefore the proportion, which the quantity of organic matter undergoing decay bears to that in a living or sound condition, we might obtain the means of estimating, whether the whole amount of nitrogen existing throughout the globe, if it were at once diffused through the atmosphere, would not communicate to it deleterious qualities.

I have said, that the *onus probandi* ought to rest with those who propound the last mentioned hypothesis, because undoubtedly a presumption would seem to exist, in favour of the view for which I have myself contended, from our having direct evidence, that the evolution of these gases, from the interior of the globe, is proceeding continually.

Hence, it seems natural, to attribute, to a phenomenon at once so constant and so general, some end in the economy of nature, and to suppose it to have been going on, like the volcanic processes which produce it, without interruption, from the beginning of time.

Granting then, what upon Liebig's principles seems most consistent with analogy, namely, that the ammonia, no less than the carbonic acid, which formed the food of the first plants, has been produced, not by processes of animal decay, but by such as were proceeding within the globe prior to the creation of living beings, the notion of a slow and continuous disengagement of both compounds, from the earliest period to the present time, will be received perhaps, as at least the most probable mode of accounting for their unfailing supply.

Whilst it relieves us from the difficulty of supposing the atmosphere surcharged with these gases at any one period, it suggests to us, at the same time, sublime and interesting views of the arrangements of the Deity, in thus having made all things subservient to one common end, and having ordained, that the mighty agents of destruction, which exist in the bowels of the earth, should minister, like the malignant Genii of some eastern fable, to the wants and necessities of the living beings, which He has placed upon its surface.

What may have been the nature of the processes which have brought about the disengagement of these gases, I have discussed at full in my work on Volcanos[q], and in other subsequent publications—at present I will only remark, that, whilst the evolution of carbonic acid indicates perhaps nothing more than the operation of subterranean heat—the escape of atmospheric air deprived of a portion of its oxygen, seems to imply, that this heat originates in internal combustion, by which oxygen is absorbed—and the disengagement of ammonia, may lead us to presume, that this combustion is connected with the decomposition of water.

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[q] Description of active and extinct volcanos. London 1826.

The latter inference appears to be unavoidable, when we recollect, that ammonia is a compound of nitrogen and hydrogen, and that the only substance which can well be supposed to supply the latter element within the interior of the globe, is water, which we also know to be abundantly present.

Water is readily decomposed, by several of those bodies, which in an oxidized condition constitute the various products of a volcanic eruption, and hence, it seems not illogical, to consider its action upon the bases of the earths and alkalies, which may still exist in the interior of the globe, as the *primum mobile* of such phenomena[r].

What, however, I am principally anxious on the

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[r] Hydrogen, it is true, does not combine with nitrogen, when disengaged by the action of potassium upon water under the ordinary pressure of the atmosphere. This I have ascertained, by introducing a lump of the metalloid into water, surrounded by an atmosphere of nitrogen; though those who repeat the experiment may accuse me of error, if they do not recollect, that the hydrogen set at liberty carries with it a portion of potassium, which acts upon wettened turmeric or reddened litmus paper, and causes it to afford indications of an alkali.

It does not follow, however, that if the experiment were made in the interior of the earth, under an enormous pressure, an union might not take place between these two elements, since they would then be brought into a condition, similar to that in which they are placed on the surface of the globe, in those cases where putrefaction liberates their respective particles from a mutual state of combination, and ammonia is accordingly produced.

In both instances the particles would be brought within the sphere of their mutual affinities; in the former by *pressure*, in the latter by being set free at the same moment from the compound which they contributed to form, and hence the same effect, which is seen to be produced under the latter circumstances, may with some degree of probability be imagined as likely to take place under the former. It is true, that chemists have not succeeded in producing present occasion to point out, is the discovery of a *final cause*, for the extrication of those gases, which I and others, in our examination of volcanos, have so frequently been led to remark; as this alone renders it probable, that the phenomenon in question is one, not of local or of incidental occurrence, but that it has gone on from the beginning of time on that gigantic scale, which is consistent with the grandeur of those operations that have occasioned it, and is adequate to those equally extensive uses, that we have ventured to assign to its agency.

Thus much at least seems clear, namely, that when we attribute, as many without due reflection appear to do, the nitrogen which plants absorb, to the products of the decomposition of animals, whilst these very animals are supposed to have obtained their nitrogen from the vegetable food on which they had themselves subsisted, we are reasoning in a vicious circle, and can hardly help being brought to the admission, that if plants are allowed to have multiplied and increased by any natural causes, they must at one time have obtained their food from inorganic matter exclusively; and moreover, that even at present, no increase to the common stock of these elements, which is treasured up already in the two organic kingdoms of nature, can take place, except it be furnished from the same identical source.

In conclusion then I may remark, that in balancing the rival pretensions of the two theories, by the aid of which it has been attempted to explain the origin of

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an union between these two gases by subjecting them to a pressure of fifty atmospheres, but it must be recollected, that neither of them were then in a *nascent* state, and that the degree of pressure said to have been employed, was very far from what would have sufficed for reducing either of these elements to a state of liquefaction.

volcanos, we cannot be justified in leaving out of the account phenomena, which, like that of the disengagement of ammonia, are of such general occurrence, and appear subservient to such important ends; and that, if the chemical theory be capable (as few, I believe, have attempted to deny[s]) of accounting for this, as well as the other products which proceed from an eruption, it ought to be adopted provisionally, as explaining the internal heat of the globe, in preference at least to that one, which considers the latter merely as the remnant of the incandescent condition, which the earth is supposed once to have possessed, but which leaves out of the consideration altogether, the chemical phenomena of a volcano, as unworthy of attention.

I ought to apologize perhaps, for indulging in such speculations, on an occasion like the present, but the subject of volcanos will not appear altogether irrelevant to that of agriculture, when I remind you, that, from the products of subterranean fire, many parts of the surface of our globe seem to derive the fertility for which they are remarkable.

All of you recollect the luxuriance attributed to the lands of Campania, the "vicina Vesevo arva jugo," which in Pliny's time bore three crops in the year, being sown once with panic, and twice with wheat, and yet when allowed to rest betwixt crops, produced, spontaneously, roses more fragrant than those which resulted from cultivation in other places—"unde vulgo dictum," says Pliny, "plus apud Campanos unguenti, quam apud cæteros olei fieri."

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[s] It was only since this Lecture was in the press, that I became acquainted with a memoir by Prof. Bischof, of Bonn, in Jameson's Journal, for January, 1841, entitled "Reasons against the Chemical Theory of Volcanos."

Any more extended discussion however on this subject would be out of character with the design of the present Lectures, and, as the Professor proposes to offer some further remarks in a future number of the same Journal, I shall abstain from all attempt to reply to his objections, until the whole of them have been put before the public.

Nor has this land, like much of that which is found in the newly settled parts of America, lost its fertility by continued cropping, but at the present day, as of old, stands distinguished even in that highly favoured region, for the abundant returns which it yields to the husbandman.

> Quantum autem universas terras campus Campanus antecedit, tantum ipsum pars ejus, quæ Laboreæ vocantur, quem Phlegræum Græci appellant.

"Yet the farms and villages," says Liebig, "are situated from eighteen to twenty-four miles asunder, and as there are no roads between them, there can be no transportation of manure."

He therefore attributes the permanent fertility of the soil around Naples, to the alkali present in the volcanic materials of which it is made up; but all felspathic rocks are charged with the same ingredient, and some of them surrender it as readily to the agents of decomposition; nor, as we have seen, is alkaline matter alone sufficient to supply plants with all the nourishment they require.

May not, therefore, the slow disengagement of ammoniacal salts, as well as of carbonic acid, from crevices in the mountain, likewise have their share in fertilizing the ground? These, by furnishing nitrogen and carbon, may in great measure supersede the want of animal manure, and if the rock happens also to contain a portion of the earthy phosphates, there is no reason, why the celebrated Terra del Lavoro should not continue to produce an unintermitted succession of corn-crops, repeated as often as the disintegration of the substratum permits, so long as the volcanic processes seated underneath it continue to send forth volumes of the gases alluded to.

The superior quality of the wheat grown in this part of Campania may perhaps be thought to confirm such a conjecture.

It would appear, that the flour of warm climates in general contains more gluten than that of colder ones[a], perhaps because heat promotes the decomposition of organic matters, and consequently renders the supply of ammonia more abundant, and to this circumstance its superior fitness for the manufacture of maccaroni is generally attributed. But the Neapolitan maccaroni is distinguished for its excellence, and hence it is probable, that the wheat grown in the neighbourhood of that city, which supplies the raw material for this

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[a] See Davy's Agricultural Chemistry, p. 141, and Mr. Hyett's interesting communication, in the Eng. Agric. Journ. No. 5, for January, 1841.

Boussingault Ann. Chemie, p. 65. 301, says, that—

Violet-bearded wheat from Alsace contains	17.3 per cent.
The same grown in the Jardin des Plantes	26.7 ——
Winter wheat grown in ditto	33.3 ——

Hermbstoedt has given the following results, Annalen der Landwirthschaft, vol. xxii. p. 1.

100 parts of wheat in soil manured with—

	Gluten.	Starch.
Human urine (dried)	35.1	39.1
Bullock's blood (dried)	34.2	41.3
Human fæces (dried)	33.1	41.4
Sheep's dung	22.9	42.8
Pigeon's dung[a]	12.2	63.2
Cow's dung	12.0	62.3
Vegetable humus	9.6	55.9
Same soil not manured	9.2	66.7

Sir H. Davy found—

100 pts. good full grained wheat, sown in autumn, to afford	19	77
100 pts. of wheat sown in spring	24	70
100 pts. of Barbary wheat	23	74
100 pts. of Sicilian wheat	21	75
100 pts. of full and fair Norfolk barley	6	79
100 pts. of Suffolk rye	5	6

[a] It seems extraordinary, that pigeon's dung should stand lower in the scale than that of sheep.

article of food, will be found to contain a larger per centage of gluten than common, the power of forming which might be communicated to it by the ammoniacal salts in which its soil so abounds.

It may appear an homely comparison, but, to liken small things with great, the analogy is complete, between the arrangements of nature, in supplying from below the gaseous materials which the crop requires for its growth, and the plan often adopted by the gardener, of placing, in a vessel underneath the roots of a plant, a body of animal manure, which, by its exhalations, communicates to it the very same principles.

Should these views receive credence, and obtain confirmation from future investigations, they will afford a proof, that geology, no less than the sister sciences of chemistry and vegetable physiology, is capable of throwing light upon questions in which the agriculturist is concerned—but of this truth it would indeed have been needless to search for proofs, in countries so distant, or by an appeal to phenomena with which the English farmer is happily unacquainted; since we shall have abundant opportunities in the course of these lectures of shewing, that it will be brought home to him by facts of which he has daily experience, and which present themselves to his notice in the common business of life—for, if it be the office of the chemist to explain the causes of those differences which exist between soils, and the means of improving them by manures, it is no less that of the geologist to point out, where those of the best description are to be met with, what resources we have at hand in the bowels of the earth underneath, or in the contiguous strata, for remedying their defect, and what facilities for drainage and other methods of amelioration the physical structure of the country may chance to supply.

APPENDIX.

Note to page 36.

The improvement that has taken place in the productiveness of the soil of this country is pointed out in a striking manner by a writer of an article "On the Progress and Present State of Agriculture," in the Edinburgh Review, for January, 1836.

Although it may be more difficult to obtain correct statistical data relative to the age of Elizabeth, it is evident that what is established with respect to a later period must hold good, a *fortiori*, with respect to one, in which every thing relative to internal improvement was in a still more backward condition.

Now the writer in question shews, that whilst the population had only increased one-sixth during the fifty years intervening between 1700 and 1750, it has more than doubled itself in eighty years, i.e. between 1750 and 1830, as may be seen by the following statement :—

Years.	Population.
1700	5,134,516
1710	5,066,337
1720	5,345,351
1730	5,687,993
1740	5,829,705
1750	6,039,684
1760	6,479,730
1770	7,227,586
1780	7,814,827
1790	8,540,738
1800	9,187,176
1810	10,407,556
1820	11,957,565
1830	13,840,751

He shews, moreover, that the increase in the number of horses, kept in the country at present, since the year 1760, is much greater than could be maintained by the supplies of corn obtained from Ireland for their support, and consequently, form an additional item, of some magnitude in calculating the amount of home produce.

He next establishes, that the population is now, and has been for some time past, incomparably better fed, consuming a much greater quantity of wheaten bread and of butcher's meat, in proportion to its amount, than at any other period of our history.

And lastly he points out, that from 1832 to 1836 the ports were shut, and consequently the vast additions made to the population, and the signally improved mode of living, have both been provided for by the extension and improvement of British agriculture.

Now if any one should for a moment imagine, that the increase in the quantity of land brought into cultivation has kept pace with this augmentation of produce, it may be sufficient to remark, that during the reign of George III., between 1760 and 1797, a period during which nine times the number of acres were enclosed than during nearly double the number of years antecedent, (that is, during the reigns of Anne, George I. and II.) the whole quantity did not exceed 2,804,197 acres. If therefore we were even to grant, that the whole of this land had before lain entirely waste, which was far from being the case, (for much of it had been subjected to the plough, although unenclosed, as in many parts of the continent,) still the increase would be by no means adequate to that of the population during that period, for we find, that in 1760 the population of England and Wales was 6,479,730, and in 1800 (only three years later than the period included within our calculation) it was 9,187,176, shewing an increase of 2,707,416, or nearly of one-third.

Now it appears, that the number of acres in cultivation in Great Britain is about 34,000,000, and the population about 20,000,000, so that as 20,000,000 of people are maintained by the produce of 34,000,000 of acres, 2,700,000 persons added to the population would require 4,590,000 acres for their support; add to which, that the land first brought under cultivation would in general possess the greatest natural fertility, so that without an improvement in the skill of the agriculturist, the 2,800,000 acres enclosed would have been by no means equivalent in value to the average of those previously subjected to tillage.

The improvements that have taken place in agriculture during the last century are placed by the same writer in a still more striking light, by comparing the methods of husbandry employed then and at present; but for this I must refer to the article itself.

ERRATA.

Page 41. *for* vulgarem *read* vulgare.
— 42. note, line 7, *for* ammonia *read* alumina.

MEMOIR

ON THE

CULTIVATION OF WHEAT

WITHIN THE

TROPICS.

BY WILLIAM HAMILTON, M.B.

> "He bringeth forth grass for the cattle, and green herb for the service of men. That he may bring
> "food out of the earth, and wiue that maketh glad the heart of man; aud oil to make him a cheerful
> "countenance, and bread to strengthen man's heart."
>
> PSALM civ. verses 14, 15.

> "arida tantùm
> "Ne saturare fimo pingui pudeat sola; neve
> "Effœtos cinerem immundum jactare per agros."
>
> VIRG. Georg. i. ver. 79

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[illegible] Mr. Hamilton [illegible]
to the [illegible]
[illegible] 11th February 1842

TO

HIS EXCELLENCY SIR R. K. PORTER, K.C.H., &c. &c. &c.

HER MAJESTY'S CHARGE D'AFFAIRES AT CARACAS,

HIS EXCELLENCY SIR W. M. G. COLEBROOKE, K.H., &c. &c. &c.

GOVERNOR AND COMMANDER-IN-CHIEF OF THE

LEEWARD ISLANDS, &c. &c. &c.

E. N. BANCROFT, ESQ. M.D.

PRESIDENT OF THE COLLEGE OF PHYSICIANS IN JAMAICA, &c. &c. &c.

AND

THE HONOURABLE J. C. LEES,

HER MAJESTY'S Chief Justice ~~ATTORNEY-GENERAL~~ FOR THE BAHAMA ISLANDS,

THE ZEALOUS AND INDEFATIGABLE PROMOTERS OF WHEAT CULTURE

IN THE WEST INDIES,

THE FOLLOWING PAGES, CONTAINING A FEEBLE RECORD OF

THEIR VALUABLE SERVICES IN THE CAUSE OF SOCIETY,

ARE MOST RESPECTFULLY INSCRIBED

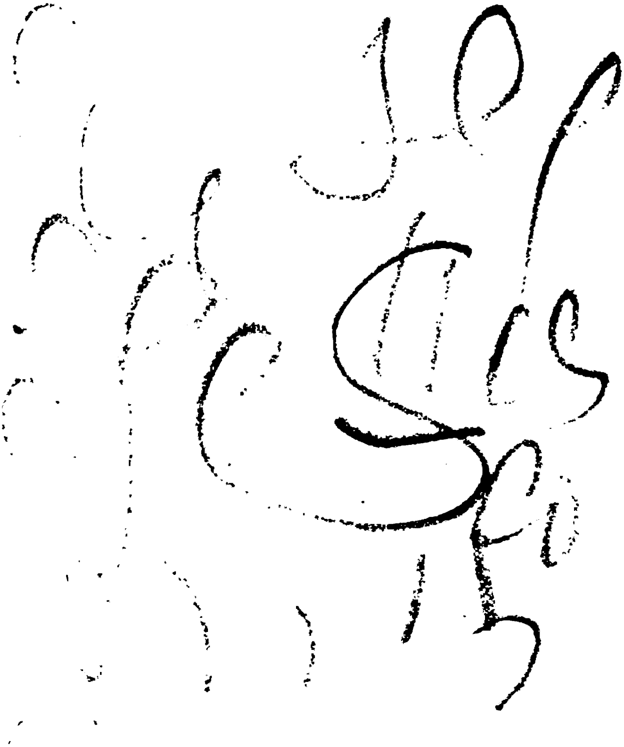
BY THEIR

MOST OBLIGED, GRATEFUL, AND DEVOTED

HUMBLE SERVANT,

WILLIAM HAMILTON.

14, OCTAGON, PLYMOUTH,
8TH SEPT., 1840.



TO THE READER.

It has been objected to the culture of Wheat in the West Indies, that its introduction will have an injurious effect upon the black population, by lessening the demand for their labour ; and were it proposed to convert the whole of the arable land in that quarter into fields of Wheat, there might be some plausible ground for the objection : since a Wheat Farm of a thousand acres may be fully cultivated by from 40 to 50 able-bodied men, aided by half as many women and children ; whilst a similar extent of land under the culture of the cane requires at least one able-bodied negro for every acre under tillage. But it is neither practicable, nor, if practicable, would it be by any means desirable to substitute the one culture to the total exclusion of the other. There are soils and situations in which Sugar will still continue to be more productive than Corn ; and my utmost aim is to exhibit, as in the Vallies of Aragua, Saccharissa and Ceres presiding without rivalry, and the golden harvests of the latter waving in union with the loftier crops of the former : thus giving the industrious labourer a choice of occupation, and enabling him to obtain wages proportionate to the degree of his toil. The culture of Corn, moreover, comes within the reach of the poorest peasant, while, from the enormous outlay of capital it requires, the precarious nature of its returns, and the necessity for grinding off the crop as fast as it is cut, the culture of the Cane is a lottery exclusively restricted to the wealthy. But, in addition to these arguments in favour of the introduction of a culture demanding less human labour than the Cane, I am warranted in stating, upon the authority of recent intelligence from the West Indies, that the labouring population is at this moment insufficient for the due cultivation of the soil ; and that means must be adopted either to augment this class of the community or to lessen the demand for human labour. "We could employ," says my correspondent, in a letter as recent as the 1st of January, 1840, "half as many more "labourers as we have. The position in which masters now stand is an "unnatural one ; instead of labourers courting employment, the masters "have to search for and make a favour of their services." This is an evil which the introduction of Wheat tillage will correct, by restoring the balance between the supply and demand to a more healthy state, and promoting that mutual dependence between the employers and the employed which forms the only cement of the social system, and has for this purpose been wisely ordained by a beneficent Providence.

But the benefits arising from the introduction of Wheat tillage into our West Indian Colonies, will not be confined to society in those regions ; they will extend their influence to the Parent State, by enlarging the market for British Manufactures, and counteracting the efforts of other nations to cripple our commerce and undermine our prosperity, by excluding our products from the markets of Continental Europe and the United States of America. In proportion as the labouring population of our islands become elevated in the scale of society, they will prove customers for our manufactures, and thus contribute to maintain our national ascendancy. "New markets," says Mr. Buxton,* in his admirable exposition of a "Remedy" for the Slave Trade, "new markets for the "sale of our manufactured articles are urgently required, at a time when "we are excluded from some of our accustomed channels of sale." No people on earth love finery more, or are more disposed to indulge their taste for it, than the natives of Africa; and the disposition, though necessarily checked by the privations of slavery, has nevertheless continued to exist among their descendants in the West Indies, waiting only for the means to exhibit its full development. Already has the abolition of slavery begun to convert the Negroes of Antigua into consumers of wheaten bread in place of Indian Corn, yams, and cassada. As their comforts increase, we shall see them clothed in the muslins of Glasgow and of Manchester, providing new marts for our merchants in lieu of the markets of Europe, from which the operation of the Corn Laws is progressively excluding them.

In letters to my correspondents in the West Indies, as well as in the course of the following pages, I have, upon the authority of practical and scientific men, recommended the use of Lime as a manure, and lime water as a means of preserving the wheat crops from the devastations of the Pepper Brand. This has been disputed by Mr. John Briggs, of Barbados: who, in a letter of the 9th of November, 1839, inserted in the *Barbados Globe* of the 18th of the same month, denies that Lime is a manure, and says that "Lime water is destructive of vegetation, and "that seeds steeped in it, as the [illegible]. recommends the Victoria Wheat "seed for being sowed, is erroneous"; and again, "Lime water is water "fully impregnated with the caustic alkali of lime. The residuum, after "being washed, if the whole of its alkali has been imbibed by that "water, or after that by the moisture of the air, and the place of the "alkali filled with carbonic acid gas (which the surrounding atmosphere "readily supplies) becomes Carbonate of Lime, a substance of as decidedly neuter effect on vegetation as siliceous sand is: therefore seeds "coated with *carbonate of lime* will not assist their vegetation."

Having already transmitted two letters to the *Barbados Globe*, in vindication of my recommendation, and having little space to spare here for entering at length into the subject, I must be brief in my notice of Mr Brigg's objections.

My advice with respect to steeping wheat in lime water previous to sowing was founded upon the suggestion of Mr. Bauer; and, so far from being likely to prove injurious to the vegetation of the seed, is calculated to promote and accelerate it, if the theory of Mr. Lymburn, which seems fully borne out by his experiments, be founded in fact. The albumen of seeds, which constitutes the food of the infant plant, consists of the following substances, which vary from each other in the proportion of the principles of which they are composed, as in the subjoined table :—

---

* The Remedy, by T. F. Buxton, Esq.,—unpublished Edition, p. 132.

	Carbon	Oxygen	Hydrogen	In all	
Gum, or Mucilage, consisting of	42.23	50.84	6.93	100	parts
Sugar	43.34	49.82	6.84	100	——
Starch, or Fecula	43.51	49.57	6.92	100	——

Seeds before attaining to maturity contain more mucilage and less starch than afterwards ; and hence recent seeds, and those just arrived at maturity, vegetate more freely and more expeditiously than seeds which have passed maturity or been long kept. This arises from the greater solubility of gum than starch, and its easier conversion into food adapted to the wants of the plant. But the chief difference between starch and gum consists in the larger proportion of Carbon, and smaller proportions of Oxygen and Hydrogen which it contains. To convert the starch into gum, therefore, we must endeavour to abstract the redundant Carbon, and supply the deficient Oxygen and Hydrogen. This we are able to effect by taking advantage of the chemical affinities of Quicklime and Water; and thus not only hasten vegetation in seeds which from overripeness would have long lain in a dormant state, but even restore vegetation in seeds which, from having been long kept, had all but lost their vitality. The Quicklime combines intimately with a portion of the water, reducing it from a liquid to a solid state, and disengaging, in the transition, a sufficiency of Caloric to aid it in decomposing the remainder : which, thus resolved into its constituent principles, Oxygen and Hydrogen, supplies, in their nascent state, the elements required for the conversion of the less soluble starch into the more soluble mucilage. At the same time a portion of the Oxygen, seizing upon the redundant Carbon, converts it into Carbonic Acid ; which, combining with the Lime, reduces it to the state of Chalk, leaving the other elements of the seed in those exact proportions which are fittest for supporting the infant life of the vegetable embryo. Air, heat, and moisture, with the absence of light, are essential to the success of this operation. Such is in brief the theory upon which Mr. Lymburn's practice rests. That practice I shall now give in his own words from his paper in vol. xiv. of the Gardener's Magazine, p. 75.—Jan. 1838.

“ Let the seeds to be experimented upon be spread upon a floor, or in
“ a box or saucer, according to the quantity, and thoroughly damped
“ (more or less according to the nature of the seed, as to its naturally
“ dry or oily condition) ; let the whole be well mixed together, so that
“ every seed may receive its proportion of moisture ; then add newly
“ slacked lime in the proportion of from one-eighth to one-tenth of the
“ bulk ; and mix the seed again well, so that every seed may receive its
“ proportion of lime ; lay it up in a heap, and when it begins to get dry,
“ have it turned and mixed, and again damped ; and continue this pro-
“ cess for a longer or shorter time, according to the known habits of the
“ seed as to speediness in vegetation ; observing not to let it be long in a
“ dry state, in which the lime will be prejudicial : and I feel confident
“ if these instructions are attended to, the result will be beneficial.”

Mr. Lymburn pursued this plan most successfully with seeds of the Spruce Fir which had been kept for three years out of the cone, and which, under such circumstances, refuse to vegetate. Treated in this manner, they grew as well as seeds sown in their first year; and this after a portion of the same seed, when younger by a year, on being damped without the addition of lime, refused to swell, acquiring a mouldy smell without germinating. Seeds of Magnolia and other plants were similarly treated and with similar success.

Here we have lime in its full causticity applied to the seed, not only without injury, but with the most striking advantage, contrary to the opinion somewhat hastily pronounced by Mr. Briggs.

An instance of the utility of lime in restoring plants to health when applied to their roots, has been recently furnished to me by my valuable correspondent, Mr. Olpherts, who says, "In your days of sojourn here, "according to all accounts, Limes and Oranges must have abounded. "We now import them. About 10 years ago, these species were simultaneously smitten with a blast which destroyed thousands upon thousands; "and it still frustrates all attempts at the formation of new plantations. "I have been attempting their cultivation here; but, until lately, like my "neighbours, utterly failed; when fortunately, being on a visit to a *brother* "Special Magistrate, I observed a Lime tree of singular beauty and "luxuriousness of growth in his garden. I naturally inquired the cause. "It appears that, like all other trees of the kind lately planted, it had "drooped, and to all appearance was dying: when, at a venture, he "applied Lime to the roots. In a short time, afterwards, it assumed its "natural verdure; and shooting forth vigorously (though but 3 years "old), is upwards of 9 feet high. The hint was sufficient for me; and "my little plantation of Limes and Oranges is the picture of health. I "have since applied this panacea to all sickly shrubs with equal success. "I presume it acts as an alterative upon the constitution of the plants; "and by its action upon the vegetable properties of the soil, produces "a pabulum suitable and invigorating."

These two cases taken in conjunction, will, I trust, convince Mr. Briggs that Lime, whether in its caustic or its mild state, is not, when applied with judgment, either pernicious or inert; and that the suggestion I ventured to offer upon the strength of Mr. Bauer's recommendation, is not altogether so erroneous as he is disposed to think it.

Mr. Briggs also objects to my recommendation of kelp upon the authority of that experienced agriculturist Col. Le Couteur, saying, that "Soils "that require Soda or Mineral Alkali (if there are any such in the world, "which I much doubt of) would benefit by such ashes; but this country "abounds with those ingredients received from the ocean, in the form of "spray; sea weed spread on, ploughed into the soil, and there decomposed by putrefaction, is highly fertilizing, even on the borders of the "ocean. But here the properties of the article are hardly worth any "consideration, as no quantities of it worthy collection are thrown upon "our shores.'

Having already considerably exceeded the limits I originally proposed to myself, I cannot now enter into this branch of the subject at any length. I shall therefore content myself with referring Mr. Briggs to what is said in the following pages; and reminding him, that Jersey, the scene of Colonel Le Couteur's experiment, is as much under the influence of the marine spray as Barbados.

ON THE

CULTIVATION OF WHEAT WITHIN THE TROPICS.

CHAP. I.

EARLIEST NOTICES ON THE SUBJECT.

It was on the 12th October, 1492, that the first land belonging to the New World presented itself to the longing gaze of the adventurous Columbus, and more than repaid him for the anxieties which had embittered his voyage from the bar of Saltes,* near Palos de Moguer, in the Province of Andalusia. The land so discovered was Guanabani, one of the countless Archipelago of the Bahamas, named by him San Salvadore, but known in our days by the name of Cat Island. Following up this discovery by that of others of the same group, together with Cuba, which he coasted to its Eastern extremity, he reached Haïti on the 5th of December, and anchored on the following day in a harbour at its western extremity, since named Cape Nichola Mole. Proceeding hence along the northern coast, he passed through the channel which divides the small island of Tortuga from the main, and founded, on the spot where stands the present town of Cape Henri, the first European settlement attempted in the Western hemisphere, to which he gave the name of La Navidad: and sailed again for Spain, on the 4th of January, 1493. Having reported his success to the Spanish Court, he reimbarked at Cadiz on the 25th of September, and arrived at La Navidad, on the 27th of November, 1493. Here he had the mortification to find his settlement in ashes and his settlers exterminated. Quitting this scene of disaster in quest of a new site for a settlement, he reached a spot about ten leagues to the Eastward of Monte Christ, where, about the 7th of December, he laid the foundation of a second town, and named it in honour of his royal Patroness, the city of Isabella. Having seen the works here in a sufficient state of forwardness, he set out on an expedition of discovery into the interior, from which he did not return before the 29th of March, 1494, highly pleased, as his biographer informs us, with the results of his excursion. But if he was thus satisfied with the result of his excursion, he had no less reason to be pleased with the progress of the settlement in his absence.

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* A small island formed by two arms of the Odiel, a river that falls into the Atlantic, a little to the Southward and Eastward of the mouth of the Guadalquiver, which forms the boundary line here between Spain and Portugal.

"The appearance of everything in the vicinity of the harbour," as his biographer* informs us, "was calculated to increase his anticipations "of future prosperity. The plants and fruits of the old world, which he "was endeavouring to introduce into the islands, gave promise of rapid "increase. The orchards, fields, and gardens were in a state of great for-"wardness. The seeds of various fruits had produced young plants; "the SUGAR CANE had prospered exceedingly in the soil: a native "VINE trimmed with care had yielded grapes of tolerable flavour, and "cuttings from EUROPEAN VINES *already began to form their clusters.* "On the 30th of March, a husbandman brought to Columbus EARS OF "WHEAT *which had been sown in the latter part of January.* The "*smaller* kind of garden herbs *came to maturity in sixteen days;* and "the *larger* kind, such as Melons, Gourds, Pompions, and Cucumbers, "*were fit for table* within a *month* after the seed had been put into the "ground. The soil, moistened by brooks and rivers and frequent "showers, and stimulated by an ardent sun, possessed those princi-"ples of fecundity which surprise the stranger, accustomed to *less* "vigorous climates, by the *promptness* and *prodigality* of vegetation."

Thus we see that the cultivation of Wheat within the Tropics commenced in the West Indies almost with their discovery, was coeval with the introduction of the Cane, and was as triumphantly successful as that of the other exotics tried by Columbus; while the crop attained to maturity in an infinitely shorter space than was required in the proverbially fine climate of Andalusia. Taking the "*latter part of January,*" to imply the interval between 21st and 31st, and the ears spoken of as ripe specimens, the interval required by the crop to reach maturity, could not have exceeded at the outside 68 days; or, assuming a mean date, 64 days, but one day beyond 9 weeks. An interval nearly corresponding, as we shall presently see, with the results obtained in the vallies of Aragua; and within about 26 days of those which have been obtained in Jamaica, New Providence, and Barbados.

Such having been the success of the first experiment, we feel naturally disposed to enquire how a culture so congenial to the habits, and so necessary to the wants of the new settlers, should have been lost sight of for upwards of 3 centuries; and should have been so completety superseded by the far more laborious, far more costly, and far more precarious culture of the Cane, (equally an exotic with itself, and equal in the antiquity of its introduction,) as to have created a belief, extending even to the most philosophic minds, that the culture of the Cerealia was incompatible with a tropical climate; and that the few instances of apparent contradiction, instead of awakening a suspicion of the soundness of the popular opinion, came to be regarded as exceptions, merely arising from some undetected causes, and serving to confirm, in place of weakening the general rule.

"Frumenti *quodcunque genus,*" says the learned Humboldt, "*calores* "*plagæ æquinoctialis ægrè tolerat,* ideoque in universum Cerealia "Europea in Orbe Novo, lat. 0°—10°, eâ altitudine coli incipiunt, quâ "in zonâ temperatâ, lat. 42°—46° ferè crescere desinunt. Tamen ob

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* Washington Irving. Life of Columbus, vol. ii. ch. xi. p. 129

" *certas causas*, locis *proprias nec satis erutas*, in Provinciâ Caracasanâ
" Triticum colitur propter Victoriam, altitudine 270 hexapodarum ; et,
" quod magis mirandum, in parte interiori Insulæ Cubæ, lat. 23, propter
" *las Quatro Villas*, in planitie *paulum suprâ mare elevatâ*."[*]

" Every kind of Corn bears with impatience the heat of the tropical " regions, and hence, the Cerealia of Europe only begin to be cultivated " between the latitudes of 0°—10° at elevations at which they nearly " cease to exist in the temperate zone, between lat. 42°—46°. Yet, from " some cause, not yet sufficiently investigated, Wheat is cultivated near " Victoria, in the Province of Caracas, at an elevation of 1725. 51 English " feet ; and *more extraordinary still*, in the interior of Cuba, in the 23rd " parallel of latitude, near Las Quatro Villas, in a plain, little above the " level of the sea." Such is the opinion, somewhat unphilosophically, if not dogmatically, expressed by one of the most enlightened and inquisitive travellers of the present or any preceding age ; and such was the unhappy effect of wide extended and long cherished popular prejudices acting upon a mind otherwise proof against vulgar errors, and prone to reject that which reason, confirmed by experience and enquiry, hesitated to admit.

What then has been the origin of a prejudice apparently so opposed to the interests, the European tastes and habits, and even to the positive experience of the earliest settlers, and their descendants ? This is the problem we have now to solve. This prejudice, so injurious in its results, so fatal to the happiness of millions, and so blighting to those fine and fertile regions, in which, as Irving most graphically expresses himself, " the soil moistened by brooks and frequent showers, and stimulated by " an ardent sun, possessed those principles of fecundity which surprise " the stranger, accustomed to less vigorous climates, by the promptness " and prodigality of vegetation,"—regions which presented, on their first occupation, the golden gifts of Ceres, the purple clusters of Bacchus, and the most common fruits and vegetables of Europe, smiling in conjunction with the Cane of the east, and the Banana of the Equator ; and almost converting this earth into a second paradise, in which man was all but relieved from his original sentence of eating his bread by the sweat of his brow—this preposterous prejudice was one of the bitter fruits of that barbarous, unchristian, and inhuman traffic in men, which the mistaken philanthropy of the benevolent and well meáning Las Casas, Garces Bishop of Tlascalá, and Pope Paul III,[†] substituted with the

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[*] De Distributione Geographicâ Plantarum secundum cœli temperiem et altitudinem montium Prolegomena. Paris, 1817, p. 161.

[†] In the early ages of our acquaintance with America, the same plea which was afterwards advanced in justification of the horrors of Slavery and the slave trade, was brought forward in extenuation of the oppression of the unhappy Indian, namely, that he was of *a race inferior to the European, little above the level of brutes, and incapable of mental or social improvement*. Garees, Bishop of Tlascala, commiserating their condition, and knowing the weight of Papal authority with his countrymen, obtained a Bull from the Pope, declaring the Indians to be men, of which the following is a copy :—

" PAULUS PAPA universis Christi Fidelibus præsentes Literas inspecturis Salutem et " Apostolicam Benedictionem. Veritas ipsa, quæ nec falli nec fallere potest, cum " Prædicatores Fidei ad officium prædicationis destinaret, dixisse dignoscitur : '*Euntes*

kindest intentions, but with the most unhappy results, in 1537, for the cruel oppression to which the aboriginal inhabitants had been subjected by their remorseless conquerors; and by means of which, the culture of the Cane, itself coeval with, and as much an exotic as Wheat, was enabled to take an almost exclusive root, superseding every less profitable object of industry, and concentrating upon itself all the cupidity and all the energies of the descendants of the invaders. Thus, from the first dawning of the African Slave Trade, that daring violation of the fundamental maxim of the Christian Faith, which commands us to *do as we would be done by*, the attention of the settlers in the West Indies became exclusively directed to an object of culture, which the almost inexhaustible supply of labour from the shores of Africa rendered so infinitely more productive than any other, as not only to create an all absorbing feeling in its favour, but at length even to produce among their descendants an erroneous, but not on that account, less strongly rooted opinion, that all other objects, and the Cerealia more especially, were not only unworthy of notice, but unsuitable to the climate. That this was not the case prior to the introduction of the African Slave Trade, we have the evidence of Humboldt himself for asserting. When discussing, in the 4th volume of his Personal Narrative, p. 112, the question of Wheat culture at La Victoria, and other places within the Tropics, this distinguished writer observes, that—

"At the beginning of the conquest the corn of Europe was *cultivated* " *with success* in several regions which are *now* thought *too hot* or *too* " *damp*, for this branch of agriculture. The Spaniards, *recently* removed " to America, were *less accustomed* to live on Maize [Zea Mays]; they " *still adhered* to their European Customs; they did not calculate whether " Corn would be *less profitable* than Coffee or Cotton; they tried *seeds of* " *every kind;* they *interrogated nature with more boldness, because their* " *reasonings were less founded on false theories*. The Province of Car- " thagena, crossed by the chain of mountains of *Maria* and *Guamoca*

" '*docete* OMNES *gentes*'; OMNES dixit, absque omni dilectu, cum OMNES Fidei " disciplinâ capaces existant. Quod videns et invidens ipsius humani generis æmulus, " qui bonis operibus, ut pereant, semper adversatur, modum excogitavit hactenùs " inauditum, quo impediret, ne Verbum Dei Gentibus, ut solvæ fierent, prædicaretur, " ut quosdam suos satellites commovit, qui suam cupiditatem adimplere cupientes, " Occidentales et Meridionales Indos, et alias Gentes quæ temporibus istis ad nostram " notitiam pervenerunt, sub *prætextu* quod Fidei Catholicæ expertes existant, *uti* " *bruta animalia*, ad nostra obsequia redigendos esse, passim asserere præsumant, et " eos in servitutem redigunt *tantis afflictionibus illos urgentes, quantis vix bruta* " *animalia illis servientia urgeant*. Nos igitur, qui ejusdem Domini nostri vices, " licet indigni, gerimus in terris, et Oves gregis sui nobis commissas, quæ extra ejus " Ovile sunt, ad ipsum Ovile toto nixu exquirimus, attendentes Indos ipsos, utpote " *veros homines*, non solum *Christianæ Fidei capaces existere*, sed, ut nobis innotuit, *ad* " *Fidem ipsam promptissime currere*, ac volentes super his congruis remediis providere, " prædictos Indos, *et omnes alias gentes* ad notitiam Christianorum in posterum deven- " turas, licet extrà fidem Christi existant, suâ libertate, et dominio hujusmodi uti, et " potiri, et gaudere libere, et licetè posse, *nec in servitutem redigi debere*, ac quicquid " secùs fieri contigerit irritum et inane, *ipsosque Indos*, et *alias gentes Verbi Dei prædi-* " *catione* et *exemplo bonæ vitæ ad dictam Fidem Christi invitandos fore*. Auctoritate " Apostolicâ per præsentes literas decernimus, et declaramus, non obstantibus præmissis, " cæterisque contrariis quibuscunque."

"Datum Romæ, anno 1537. IV. Non. Jun. Pontificatus nostri Anno III."

" produced Wheat till the 16th century.* In the Province of Caracas this " culture is very ancient among the mountainous lands of *Tocuyo, Quibor,* " and *Barquesimeto,* which connect the littoral chain with the *Sierra* " *Nevada* of *Merida.* It is *still* happily practiced there, and the environs " of *Tucoyo alone* export annually *more than eight thousand quintals* " *of excellent flour.* But though the Province of Caracas, in its vast " extent, presents several spots *very favourable* to the cultivation of " European corn, I believe that this branch of agriculture will never " become of great importance there. The most temperate vallies are not " sufficiently wide, they are not real table lands; and their mean eleva-" tion above the level of the sea not considerable enough for the inhabi-" tants to avoid perceiving, that it is *more* their interest to establish " plantations of Coffee than to cultivate corn. Flour *now* comes to " Caracas *either from Spain, or from the United States.* When, in " circumstances *more favourable* to industry and public tranquillity, the " road from *Santa Fe de Bogotà* to the port of *Pachaquiaro* is laid open, " the inhabitants of *Venezuela* will receive the flour of *New Granada,* " by way of the *Rio Meta* and the *Oronoco.*"

From this we learn, not only that the culture of wheat so successfully introduced into Haïti by Columbus towards the close of the 15th century, had extended to the main land, but that it continued to be successfully prosecuted there in regions *now* erroneously deemed unsuitable to its growth, as late as the middle of the following century; when the increased facilities afforded to the culture of the Cane, by the introduction of the Slave Trade, operated so powerfully to the exclusion of Wheat, as to create an almost total oblivion of its former flourishing existence, and give birth to an unfounded prejudice; the effect of which has been to render the modern inhabitants of these very regions dependant for their supply of this necessary article of human sustenance, upon distant countries, and far less favourable climates.†

Other causes appear to have concurred with the African Slave Trade, in excluding not only the culture of the Cerealia, but likewise the manufacture of wine and other objects of European industry, from Haïti, under the Colonial Regime, which are fully explained in the following passages extracted from the " Reflections Politiques" of my talented and lamented friend, Baron de Vastey, page 108 et seq., upon which comment is unnecessary:

" Le Gouvernement a tentè plusieurs essais, dejà on a *seme et rècoltè*

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* Don Ignacio de Pombo. '*Informe del real Consulado de Cartagena de Indias.*' 1810. p. 75. There is a striking coincidence between this date and that of the Papal Bull.

† Similar causes, we are told, produce similar effects; and this is strikingly verified in the culture of Corn in other regions within the Tropics than those of the Antilles and America; where its discontinuance in modern times is distinctly and unequivocally traceable to the withering influence of this unchristian and inhuman traffic. "Quihi-" mane," says Commodore Owen, (who was employed in a survey of the African coast about 1823 and 1824,) "produced grain in such quantities, as to supply Mozambique; " but *the introduction of the Slave Trade* stopped the pursuits of industry, and " changed those places, *where peace and agriculture had formerly reigned,* into the " seat of War and Bloodshed." This passage is taken from Mr. Buxton's appalling work on the African Slave Trade, as quoted in the Evening Mail of the 8th to the 11th of November, 1839.

"du Blé, de l'Orge, de l'Avoine, et nous avons eu la preuve evidente "que si nous n'avons pas joui depuis long temps de ces produits substanciels, *cela n'a été que par la malice, et les intérêts combines des* "*ex-colons avec leur métropole*; les Carthaginois, pour mieux imposer "leur joug aux Siciliens, leur défendirent sous peine de mort de semer "le Blé; dans le Régime Colonial, il etait pareillement défendu à Saint "Domingue de *cultiver le Blé*, et *la Vigne pour faire du Vin*, sous "les peine les plus sévèrès." Government has made many experiments: already has it *sown*, and *reaped Wheat, Barley*, and *Oats*; and we have ample proof that our having been so long without these substantial productions, has arisen only from the malice of the excolonists, and the identity of their interests with those of the mother country. The Carthaginians, the firmer to impose their yoke upon the Sicilians, forbade the cultivation of Wheat under pain of death. In like manner, under the Colonial system, the cultivation of Wheat, or of the Vine, for the manufacture of Wine, was prohibited under the most severe penalties, and to establish the latter part of his charge he adds the following striking fact in a note:

"M. de Soleil, habitant de Gonaïves, ayant fait *un Vin potable*, en fit "gouter à M. de Bellecombe, alors Gouverneur, qui pour prix de son "zèle et de son industrie, le fit mettre en prison, et condamner à une fort "amende." M. de Soleil, a Planter of Gonaïves, having made some pleasant wine, gave a portion of it to M. de Bellecombe, who was then Governor, to taste; who rewarded his zeal and industry by fine and imprisonment.

Here then, and not in any unsuitableness of either climate or soil, are to be found the true reasons why neither Corn nor Wine have been for ages past among the products of the fine and fertile island of Haïti; although the first of the Antilles to receive both the corn and vines of Europe from the patriotic bounty of the adventurous Columbus.

Such are the few historical details which I have been able to collect respecting the first introduction and subsequent progress of Wheat tillage in Haïti, that queen of the Antilles. Of the other islands, with the exception of Cuba, I have not been able at present to obtain any information; the few facts which have been furnished as to its cultivation in Cuba, at a level nearly corresponding with that of the sea, are contained in the account given by Humboldt, of the agriculture of La Victoria, in which we have the satisfaction of learning the state of this branch of industry as late as the 11th of February, 1800, when these interesting regions were visited by that illustrious traveller.

"The environs of La Victoria," observes Humboldt,* "present a very "remarkable aspect with regard to agriculture. The height of the cultivated ground is from 270 to 300 toises† above the level of the "ocean; and *yet we there find fields of Corn mingled with plantations* "*of Sugar Cane, Coffee, and Plantains.* Excepting the interior of the "island of Cuba,‡ we scarcely find any where else, in the equinoctial "regions, European Corn cultivated in large quantities in so low a

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* Pers. Narr. vol. iv. p. 104.

† 1,726.91 to 1,918.4 English feet, at 6.3945 feet to the toise.

‡ The District of Quatro Villas.

“ region. The fine fields of Wheat in Mexico are between 600 and
“ 1200 toises* of absolute elevation, and it is rare to see them descend to
“ 400 toises.† We shall soon perceive that the produce of grain *augments*
“ *sensibly*,‡ from high latitudes towards the equator, *with the mean*
“ *temperature of the climate*, in comparing spots of different elevations.
“ The success of agriculture depends on the dryness of the air ; on the
“ rains distributed among different seasons, or accumulated in one rainy
“ season ; on winds blowing constantly from the East, or bringing the cold
“ air of the North into very low latitudes, as in the Gulph of Mexico ; on
“ mists, which for whole months diminish the intensity of the solar rays ;
“ in short, on a thousand local circumstances which have less influence on
“ the temperature of the whole year, than on the distribution of the same
“ quantity of heat among different parts of the same year. It is a
“ striking spectacle to see the grain of Europe cultivated from the
“ Equator as far as Lapland, in the lat. of 69°, in regions where the
“ mean heat is from 22° to 2°‖, in every place where the temperature of
“ summer is above 9° or 10°.§ We know the *minimum* of heat requisite
“ to ripen Wheat, Barley, and Oats ; we are less certain in respect
“ to the *maximum* which these species of grain, accommodating as they
“ are, can support. We are even ignorant of all the circumstances which
“ favour the culture of Corn between the tropics at very small heights.
“ La Victoria and the neighbouring village of San Matheo yield an
“ annual produce of 4,000 quintals of Wheat. It is sown in December,
“ and the harvest is reaped on the 70th or 75th day. The grain is
“ large, white, and abounding in gluten ; its pellicle is thinner and not
“ so hard as that of the Wheat of the very cold table lands of Mexico.
“ An acre¶ near Victoria generally yields from 3,000 to 3,200lbs.
“ weight of Wheat. The average produce is consequently here, as at
“ Buenos Ayres, 3 or 4 times as much as that of northern countries.
“ Nearly sixteen times the quantity of seed is reaped, while, according to
“ Lavoisier, the surface of France yields on a mean only 5 or 6 for 1 ;
“ or from 1,000 to 1,200lbs. per acre. Notwithstanding this fecundity
“ of the soil, and this happy influence of the climate, the culture of the
“ Sugar Cane is more productive in the vallies of Aragua than that of
“ Corn. La Victoria is traversed by the little river Calanchas, running
“ *not* into the Tuy, but into the Rio Aragua. It thence results that
“ this fine country, producing *at once Sugar and Corn*, belongs already

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* 3,836.7 to 7,673.4 Feet.

† 2,557.8 Feet.

‡ “The Cerealia, or common grain, as Wheat, Rye, Barley, and Oats, thrive where “ the mean temperature descends to 28°. F. provided that of Summer is 52° or 53°.” Encycl. of Geog. vol. 1. This writer, however, assigns no maximum to the temperature at which the Cerealia cease to flourish.

‖ 71°.6 to 28°. 4 Fahrenheit.

§ 48°.2 to 50. Fahr.

¶ “An *Arpent des eaux et forêts*, or legal acre of France, of which 1.95 make an “ Hectare. It is about 1¼ acre English.” This is at the rate of from 2,160 to 2,560 lbs. from an English Acre. Mr. B. T. Young estimates the produce of an English Acre in Barbados at 3,000lbs. Under an improved system of husbandry, there can be no doubt that the return admits of being enormously increased. In Jamaica, as we shall presently see, a return of 1,500 has been obtained from a single grain ; while, in the Bahamas, Mr. Storr obtained from 3 to 5,000 for one. According to Lavoisier's estimate, the produce of an English acre in France does not exceed from 800 to 960lbs.

"to the basin of the Lake of Valencia, to a system of interior rivers, "which do not communicate with the sea. We visited at sunset the "little hill of Calvary, where the view is extremely fine and extensive. "We discovered on the W. the smiling vallies of Aragua, a vast space "covered with gardens, cultivated fields, clumps of wild trees, farms "and hamlets. Turning towards the S. and S.E. we see, extending as "far as the eye can reach, the lofty mountains of La Palma, Guayraima, "Tiara, and Guiripa, which conceal the immense plains or steppes of "Calabozo. This interior chain stretches to the W. along the lake of "Valencia, towards the Villa de Cura, the Cuesta de Yusma, and the "denticulated mountains of Guige. It is very steep, and constantly "covered with the light vapour, which in hot climates, gives a vivid "blue tint to distant objects, and far from concealing their outlines, "renders them more strongly marked. San Matheo, Turmero* and "Maracay are charming villages, where every thing announces persons "in the most easy circumstances. We seemed to be transported to the "most industrious parts of Catalonia. Near San Matheo we find the "last fields of wheat, and the last mills with horizontal hydraulic wheels. "A harvest of 20 for 1 was expected;† and, as if the produce were but "moderate, I was asked whether corn produced more in Prussia and in "Poland."‡

Such is the interesting and instructive account, given by Humboldt, of the satistics of this species of husbandry; and of the localities in which it was then, and yet continues to be found. This I have deemed it better to lay before the reader in one unbroken narrative, and in the author's own graphic language, reserving any observations necessary to be made, for notes or for the future pages of this memoir. Since the period of Humboldt's visit, the cultivation of Wheat has, according to the most unquestionable evidence, greatly declined; not from any deterioration of the climate or soil, which remain the same as they were 40 years ago, but from the desolating effects of that sanguinary struggle which emancipated these fair and fertile regions from the leaden despotism of the parent state; and from the unsettled and disorganized state of society which has been the sad but unavoidable sequel of that fearful contest. It has not, however, been by any means abandoned, as Mr. Burnley, a planter of Trinidad, would have us believe; when he asserted, in his evidence before a Committee of the House of Commons, upon I know not what authority, that *all* the wheat introduced into England, and thence distributed to the West Indies, and other parts of the world, as the *celebrated Wheat of La Victoria*, was the produce of the elevated regions of Barquesimeto, of Merida, and of Tocuyo, and not of the more lowland district whose name it bore. Feeling Sir R. K. Porter, and myself, to whose kindness I was indebted for my supplies of this valuable grain, thus directly charged with the practice of a gross imposition, and the extensive circulation of an impudent falsehood, I felt it due both to that gentleman and myself, to obtain the means of repelling so wanton a charge, and vindicating our veracity from so base an imputation. With this view, therefore, I transmitted to Sir Robert an extract of that portion of Mr. Burnley's evidence; and had the satisfaction to receive a reply of the date of the 2nd of Janaary, 1838, of which the following is an extract:—

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* The village of Turmero, 4 leagues from San Matheo, is remarkable for being in the vicinity of a gigantic Mimosa, of unknown antiquity, whose hemispherical head, which appears to have varied but little from its dimensions at the time of the conquest, measured in 1800, when Humboldt visited it, 576 feet, with radii of 192, and 186 feet; and in May, 1837, when measured by Sir R. K. Porter, the circumference of its trunk 4 feet above the earth, was 29 feet, its height 84, and the diameter of its head, 202 feet; it is named *Zamang del Guayre.*

† This was on the 14th of February: hence the time of sowing must have been about the 9th or 10th of the preceding December.

‡ Personal Narrative, vol. iv. p. 102.

"With respect to what Mr. Burnley says as to the spot where
" the Victoria Wheat* sent to England grew, his assertion arose from
" *false information* he received when at Victoria; and surely you have
" evidence of origin as to the growth of what I furnished you with from
" time to time, which was produced *at a very short distance from*
" *Victoria, on the side of San Matheo.* I saw Mr. Burnley, when he
" was here; and on the receipt of your letter, mentioned the substance
" of what that gentleman reported (as stated by you to me) to the person
" who attended him hither from hence, and whom he sent to seek a
" portion of the Wheat in that town. But he certainly did not give him
" the answer, on not procuring any, that *it all came from Merida!*
" However this is of little consequence, as you know, without a doubt,
" by me, from whence it comes. None certainly is the growth of the
" *immediate* vicinity of *Victoria*, but that being the chief place from
" whence it is sent to other parts, the Wheat bears its name, as *Stilton*
" *cheeses* with us do that of *Stilton*, notwithstanding none is ever made
" there or even near it."

While speaking of what Humboldt notices as so remarkable a fact, the concurrent cultivation of the Cerealia of Europe, and the productions of the tropics at a moderate elevation above the sea, I felt myself bound to give this explicit testimony of Sir R. K. Porter, in unqualified contradiction of the statement *volunteered*, (without any apparent necessity, or any very intelligible motive, unless perhaps that of throwing discredit upon the successful effort made by the inhabitants of these regions to shake off the withering incubus of Spanish misrule,) by Mr. Burnley, in his examination before the Committee, by whom it was published along with the other evidence appended to their report ; and, likely, from this circumstance, if left without contradiction, to carry with it a weight of authority to which it has not the slightest shadow of pretension.

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* Victoria was, in 1800, a town of considerable commercial importance, with a population of 7,000 souls, fine buildings, and a church with doric columns; its latitude, as determined by Humboldt, on the night of the 11th of February, is 10°. 13'. 35''. The quarter of the town West of the Rio Calanchas, called *la otra banda*, was the most commercial, exhibiting entire streets of shops and merchandize in every direction. Two commercial roads passed through it; that of Valencia, or of Puerto Cabello, and that of Villa de Cura or the plains, called el Camino de los Llanos. The white population exceeded that of Caracas; yet, notwithstanding its size, population and importance, it was only ranked as a Pueblo or Village. It suffered severely in the earthquake which preceded the eruption of the Souffriere in St. Vincent, in 1812, and I am unacquainted with its present condition. The road from Caracas, after passing the pretty village of Consejo or Mamon, takes a S. and S. W. direction; soon after which the traveller loses sight of the Rio Tuy, which, turning to the E. forms an elbow at the foot of the mountains of Guayraima, on its way to join the Guayra, and pour their mingled waters into the bay of Higuerota. "As we drew near Victoria," says Humboldt, "the ground
" became smoother; it looked like the bottom of a lake, the waters of which have been
" drained off. We might have fancied ourselves in the valley of Hasli in the Canton of
" Berne. The neighbouring hills, only 140 toises (895.25 English feet) in height, are
" composed of *calcareous* tufa; but their abrupt declivities project like promontories
" into the plain. Their form indicates the ancient shore of the lake. The eastern
" extremity of this valley is parched and uncultivated." Pers. Narr. iv. p. 101.

Since the emancipation of South America from the iron yoke of the parent state, and the abolition of Negro Slavery which followed, the unsettled and disorganised state of society has been unfavourable to agricultural, or any other kind of social improvements ; hence, notwithstanding the peculiar fitness of the soil, *from its calcareous nature**, for the culture of Wheat, the grain has, through *careless husbandry* and most probably *deficient manure,* greatly degenerated from what Humboldt describes it : being neither so large or so white as he represents it. In this respect, however, it admits of very material improvement from the application of science and skill ; as is evident from the trials, yet in their infancy, to which it has been subjected in Jamaica, the Bahamas, Barbados, and others of our British Islands. Wheat is one of those plants, which appears to have been expressly created for the use of man, and to have been uniformly found in connexion with him ; at least I am not aware of its having been ever met with in situations in which its origin could not be distinctly traced to artificial cultivation. Humboldt indeed, upon I know not what authority, speaks of it as growing spontaneously in Persia and Armenia.‡ But his expression " Cerealia" is so vague as to leave it doubtful, whether his observation applies to the whole, including Wheat, or is to be restricted to the remaining sorts, Barley, Oats and Rye. Linneus, in his Species Plantarum, assigns to the *Triticum æstivum,*‡ upon the authority of Heinzelman, the plains of Bashire as a spot in which it grows ; but since he is silent as to its growth being spontaneous, we may conclude its presence there to be merely the result of its having accompanied man in his migrations.

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* See preceding note.

† " Vix necesse est, ut moneamus, ante quam Novus Orbis per Hispanos patefactus " esset, indigenas hujus terræ continentis insularumque adjacentium, ex Graminearum " ordine, neque *Saccharum Officinarum,* neque *Cerealia nostra* (in Musicani regione, " inter Cyrum et Terekum, in Persia et Armeniâ *sponte suâ* crescentia) neque *Oryzam* " *sativam,* cognovisse." De Distr. Geog. Plant. p. 215.

‡ " T. Calycibus quadrifloris ventricosis glabris imbricatis aristatis. Hort. Ups. 21. " Sp. Pl. Ed. 3a. 1761. vol. 1 p. 126. Habitat apud Bashiros, in campis. Heinzelman." At page 118 of the same work, an American locality is assigned to the *white* variety of the *Avena sativa,* or common Oat, which Linneus says, upon the authority of Lord Anson, inhabits the island of Juan Fernandez, where its origin may have been purely accidental, from seed left by some casual visitor from the Spanish colonies. But neither to the *Triticum Hybernum,* or common Winter Wheat ; *Secale cereale,* or Rye ; *Hordeum vulgare* ; *H. hexastichon* ; or *H. distichon,* the species of Barley in most common cultivation, does he assign any habitat. Aiton, in his Hortus Kewensis, vol. 1. p. 171, 178, and 180, follows the example of Linneus in every respect but that of the Triticum æstivum, which he leaves like the rest without any assigned habitat. With respect to the Oats found by Lord Anson, in Juan Fernandez, it must be recollected that, though not colonized previous to his visit, that island was occasionally visited by Spanish and other vessels, from some of which the seed may have been dropped, the progeny of which fell under his Lordship's notice.

Hence, notwithstanding the somewhat apocryphal remark of Humboldt, the native seat of the *bearded* or Summer Wheat, as well as the Winter or Lammas Wheat, *without awns*, (a variety probably, of the former rendered permanent by long cultivation,) may be considered as involved up to the present moment, in the greatest obscurity. Probability is, indeed, strongly in favour of the habitat assigned by Humboldt, from its proximity to the spot where Noah quitted the ark, and became the first husbandman after the flood. Certain it is, that it has been known from the earliest state of authentic records as one of the most valuable companions of man, from the more genial regions of tropical Asia to the most severe and forbidding climates; heralding, in almost every instance, the march of civilization, preparing the way for Arts and Manufactures, improving the tone of society, and exhibiting, in the most impressive manner, the munificence of that benignant Providence, which has not only given "Bread to strengthen man's heart," but endued it, at the same time, with that elasticity of constitution which enables it to adapt itself to almost every variety of climate that man himself is capable of inhabiting; from the rigours of Lapland, in plains of small elevation, as far N. as 60°. 30′, to the ardent suns and parched soil of Barbados, nearly at the level of the sea, within 13°. of the line; and the more temperate regions of Caracas, within 10 degrees of it.

If we assume, according to the statement of Humboldt strengthened by probability, Asia to have been the original seat of this inestimable grain, as well as of the human race (the cradle of both having been either within, or close upon the confines of the tropic) it follows, as an almost inevitable conclusion, that a climate, approaching to the temperature of the tropics, was the best adapted for its cultivation, and that in which its peculiar properties must be most fully developed.

In the Panjab, or northern portion of the plain of the Indus, extending from the lower ranges of the Himalaya mountains, to the confluence of the Chenaub with the Indus, (forming a vast isosecles triangle, with its base of 450 miles resting on the line of the Himalaya, and its legs of 600 miles each converging towards the confluence of the rivers, the mean elevation of which is about 1,000 feet, and the mean annual temperature, as far as can be computed from the meagre data in our possession, not less than 79°* situated between the 34th and 29th parallels of N. latitude,) Wheat is raised, *in conjunction with the Sugar Cane*, in sufficient quantity for the consumption of the inhabitants. This is indeed an extratropical region, distant, at its nearest point, about 5° from the tropic of Cancer; but nevertheless, the mean temperature of the cycle of vegetation of corn, cannot be much, if at all below that of the hottest parts of the West Indies; since the Cane, which takes nine months to attain maturity, is extensively cultivated there.

On the elevated table land of the Nilgerry mountains, (between the parallels of 11° 10 and 11° 35, and consequently little more than one degree farther from the line than Victoria,) wheat is successfully raised at elevations of from 5,000 to 6,000 feet, (nearly corresponding to the elevation of wheat tillage farther N. on the table land of Mexico,) with a mean annual temperature of between 56° and 64° ; the changes being very slow and the daily difference rarely exceeding 2°. The temperature at Utakamond, 7,000 feet above the sea, has been seen as high as 69°, and as low as 20°, or 12° below freezing. This great fluctuation of temperature was witnessed, however, but once in 12 years.

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* In Lahore the temperature in July has been known to reach 100°; a degree of heat rare in the West Indies in the shade; while it has been seen in January, as low as 24° or 8° below the point of congelation. In Multan it rises still higher; and in other places to 110°. This elevated temperature is usually accompanied by violent N. W. winds or tornadoes, which, though rarely lasting above an hour at a time, sometimes recur for several days in succession. Rain falls at irregular periods throughout the year, but most abundantly in July.

The coast of Mozambique, occupies a position in the southern hemisphere, nearly corresponding with that of the Antilles in the northern ; it stretches along the Eastern coast of Africa, from Cape Delgado in 10° 41' S. to the Northern mouth of the River Zambesi, in 17° 30' S. forming the Western coast of the streight known by the name of the Mozambique channel. The whole of this tract, within an elevated beach of about 15 feet high, (formed of sand covered with bushes and of moderate width,) is said to be a low swamp of great extent and considerable depth dotted with clumps of trees growing on elevated mounds. The extent of this morass from the shore is uncertain : but at 30 miles inland the banks of the rivers are said to be high, and the country cultivated ; there is, however, neither mountain nor elevated table land nearer the sea than 180 miles, on the banks of the Zambesi ; nor is any thing like high land visible from the sea. The year, as usual within the Tropics, is divided between the rainy and dry seasons ; the former commencing in November, and lasting till March, when the rain falls in torrents and the lands bordering on the rivers are inundated. The heat of summer is intense, but the want of records leaves us in ignorance of the mean temperature both of the year, and the several seasons and months. Yet, as we learn from the Penny Cyclopedia*, this region, apparently so unfavourable to the culture of the Cerealia, is rich in vegetable productions. "The grains "which are cultivated, are Rice, Millet, Maize, and a small quantity of "Wheat† : the most common vegetables are Cabbage, Lettuce, Spinach, "Peas, and Beans of different kinds, Tomatos, Pumpkins, and Cucum-"bers. The fruits are Cocoa Nuts, Mangoes, Oranges, Limes, Acajoa "Apples, Custard Apples, Pine Apples, Guavas, Bananas, and "Plantains."

In the Mauritius (nearly corresponding in latitude with Xalapa in Mexico, but in the opposite hemisphere ; being situated between 19° 42′ and 20° 33′ S.) Wheat, as we learn from the 15th vol. of the Penny Cyclopedia, is raised in small quantities, but at what seasons, or what elevations we are not informed. The mean annual temperature is said to be 76°, or about 3° above that of the interior of Cuba, at elevations of from 320 to 512 feet. In 1832 the range of temperature extended to 27°, or from 87° the highest, to 60° the lowest. Thirty eight inches of rain fell between the 31st of October, 1831, and 30th September, 1832. Here, as in the vallies of Aragua, the demon of slavery has had the effect of confining the culture of Wheat within the narrowest limits, through the increased facilities it afforded for the more costly and uncertain, although more attractive culture of the Cane. The abolition of Slavery there, however, as well as in the other possessions of Great Britain, will, it may be hoped, lead in time to its progressive extension; and, with this extension, to an amelioration of the condition of society at large.

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* Vol. xv. p. 466. Art. MOZAMBIQUE.

† It is sufficiently clear that if wheat can be raised in a *small quantity*, there can be no *physical* obstacle to its production upon a more extended scale—the question is one of *degrees* only.

On the reduction of the Dutch Settlements in Java, in 1811, by a British force dispatched from India, consisting of 5,000 Europeans and as many Sepoys, all of whom were bread-eaters, the supply found at Batavia, as his Excellency Sir W. M. G. Colebrooke, who served on the expedition, informs me, in a letter from Antigua of the 25th of November, 1838, was not only scanty, but consisted of musty American Wheat and Flour, ill suited either to the palates or stomachs of those who had been accustomed to better food. "The distress," says Sir William, "was "great and the communication precarious. Our first supplies came from "India; but *we soon commenced the cultivation of wheat in the hills,* "*and supplied ourselves with excellent bread;* and when the Dutch "returned in 1816 they were glad to witness our success. The Bengal "Wheat is a bearded sort, and this I believe is the most hardy." Here we have the case of the Spanish Conquestadores over again. Men accustomed to the Corn of Europe, with little relish for Tropical products foreign from their accustomed tastes, panted for their customary diet of Wheaten Bread; and, seeing no source of supply within an accessible distance, scorned the timid theories of visionary philosophers, and without pausing to weigh the probabilities of success, and solve before hand the problem of the fitness or unfitness of Wheat culture at moderare elevations within 6°. 10′ of the line, boldly cut the Gordian knot, and obtained a practical solution of the question, by at once interrogating Nature herself, and extorting from her a triumphant and satisfactory response.

These facts all confirm the observation made by Humboldt,* that "*it is an error*, that generally prevails under the Tropics, to consider "Grain as plants which *degenerate in advancing towards the Equator;* "and to believe that the harvests are *more abundant in the northern* "*climes.* Since calculations have been made on the progress of "Agriculture in the different zones, and the temperatures under the "influence of which Corn will flourish, it has been found that, beyond "the latitude of 45°, *the produce of Wheat is no where so considerable* "*as on the northern coasts of Africa, and on the table lands of New* "*Grenada, Peru, and Mexico.* Without comparing the mean "temperature of the *whole* year, but only the mean temperature of the "season which embraces *the cycle of the vegetation of Corn,* we find the "three months of summer† in the N. of Europe, from 15° to 19° (59°

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* Pers. Narr. vol. iv. p. 110.

† "The *mean heat of the summers in Scotland,* in the environs of Edinburgh, lat. "56°, is found again on the table lands of N. Grenada, so rich in wheat, at 1400 toises "(8,952.3 feet) of elevation, and at 4° of lat. On the other hand we find the *mean* "*temperature* of the Vallies of Aragua, lat. 10° 13′, and of all the plains that are not "very elevated, in the torrid zone, in the *Summer Temperature* of Naples and Sicily, "lat. 39° to 40°. These numbers indicate the situation of the *isotheric* lines (lines of

"'to 66°.20 F.); in Barbary and Egypt, from 27° to 29° (80°.60 to "86°20 F), within the Tropics between 14 and 600 toises of height "(8,952.3 and 3,836.7 feet) from 14° to 25° of the centigrade "thermometer (57°.20 to 77°.90 F.) The fine harvests of Egypt, and "of the Kingdom of Algiers, those of the Vallies of Aragua, and the "interior of the island of Cuba, sufficiently prove that the *augmentation* "*of heat is not prejudicial to the harvest of Wheat*, and other alimentary "grain, *unless it is attended with excess of drought or moisture.* To "this circumstance, no doubt, we must attribute the apparent anomalies "that are sometimes observed between the Tropics in the inferior limits "of Corn.* We are astonished to see to the E. of the Havannah, in the "famous district of *Quatro Villas*†, this limit descend *almost to the* "*level of the Sea*; while, to the W. of the Havannah, on the slope of "the mountains of Mexico and Xalapa, at 670 toises (4329.091 feet) of "height, the luxuriance of vegetation is such that Wheat does not form "ears."‡

The anomaly here spoken of, as characterizing the temperate region in which the agreeable and healthy town of Xalapa is situated, if not originating, as I am somewhat disposed to suspect, in the hasty deduc-

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"the *same summer heat*) and not that of the *isothermal* lines (those of *equal annual* "*temperature.*) Considering the quantity of heat received on the same spot of the "globe during the whole year, the mean temperature of the Vallies of Aragua, and the "table lands of N. Grenada, of 300 and 1400 toises of elevation (1918.35 and 8952.3 "feet) correspond to the mean temperature of the coasts, at 23° and 45° of lat.— "For the basis of these calculations, see my Essay on the distribution of heat in the "Mem. de la Soc. d'Arcueil, vol. iii. page 516 and 579, and above vol. iii. p. 459." The basis here referred to is as follows. "At Santa Fè de Bogotà, the month of "January, according to Mr. Caldas, differs from the mean of the year only 0°.2 "(0°.36 F.) At Mexico, very near the temperate zone, the difference reaches a "maximum of 3° (5°.4 F.) At La Guayra, near Caracas, the coldest month differs "from the annual mean 4°.0 (8°.82 F), but if the air of La Guayra (and that of Catia) "rises sometimes in winter by the Quebrada de Tipe, to the high valley of Caracas, "this valley does not the less receive, during a great part of the year, the winds of the "E. and S.E. coming from Caurimare and the inland country. We have learned by "direct observations, that at La Guayra and Caracas, the coldest months are 23°.2 "and 20°.1. (73°.76 and 68°.28 F) These differences express a decrement of heat "which is the simultaneous effect of the situation (or of the dilatation of the air in the "ascending current) and of the conflict between the winds of Catia and Petare." Pers. Narr. vol. iii. p. 459.

* "Since our return to Europe, M. Caldas has collected a great number of observa- "tions on this limit, in a Memoir which ought to be found among the papers of our "illustrious friend, Don Josè Celestino Mutis. See Spanish translation of my Geo- "graphy of Plants, in the *Semanario de Nueva Grenada*, vol. ii. p. 187."

† Anxious to obtain some information respecting the present state and statistics of the Wheat Agriculture of this district, I addressed a letter of enquiry to Mr. Tolme, the British Consul at the Havannah, on the 12th of October, 1838; but have not, up to the present moment, (26th June, 1840,) been favoured by that gentleman with any reply. From a statement in the account of Cuba, given in the 13th Vol. of the Penny Cyclopedia, page 203, published in 1836, it would appear, as though the culture had been discontinued since the time of Humboldt, it being expressly stated there, that "the "Cerealia of Europe are not cultivated *in any part* of Cuba." If this be correct, it only confirms more strongly the remarks already made with respect to the mischievous effects of Slavery and the Slave Trade, since no change in the climate or soil of the district of Quatro Villas can account for it.

‡ Pers. Narr. vol. iv. p. 111.

tions of popular credulity, arises, most probably, from the joint operation of excessive atmospheric humidity, and the redundant fertility of the soil, untamed by the hand of culture during ages of unbroken repose. That this is at least a probable explanation of this supposed anomaly, may be inferred from Col. Le Couteur's notice of the effect of an injudicious use of liquid manure, in his valuable and instructive work "*On the Varieties* "*Properties and Classification of Wheat,*" in which he informs us, at page 46, that "Liquid manure, one third stable drainings and two "thirds water, which I caused to be poured once over wheat that was "just tillering, made the straw grow rank and coarse; the grain of every "variety of wheat was dark and thick skinned, hence containing less "meal. The same quantity and mixture of liquid manure, poured a "second time over another portion of wheat, caused it to grow so rank "and full of *leaves* rather than *straw*, that *only a few of the plants* "*produced ears of wheat, some having run up into sharp points* with "*merely rudiments of ears* indicated. The few ears that produced corn, "displayed it in its worst form, hardly in the shape of meal, of a doughy "soft texture, evidently unfit for the food of man; besides some of them "were smutty. Thus an *over application* of manure, *excellent* when "*judiciously* applied, *becomes a poison,* precisely in the same manner "as, in the human constitution, a surfeit is usually the parent of some "disease."

If such were the effect which followed, in the temperate and comparatively dry climate of Jersey, merely the redundant use of manure in the form fittest for absorption, can we be surprised at a similar effect resulting, in a somewhat exaggerated form, from the joint action of *high temperature, great humidity,* and the *exuberant richness of an almost virgin soil,* composed, like that immediately surrounding Xalapa, chiefly of vegetable mould produced from the accumulated decay of vegetable matter, and the falling leaves of the forests through a long succession of centuries. The region of which Xalapa forms the delightful capital, is at that precise point of elevation, about 4,264 feet, to which, as Humboldt himself has elsewhere* informed us, the vapours ascending above the plains adjoining the sea, begin to be condensed into clouds, "from "which circumstance," as he proceeds to observe, "these temperate "regions situate on the declivity (for instance the environs of the City of "Xalapa), are frequently enveloped in fogs."

It is then to this cause, or rather this combination of causes, and not to the mere elevation of temperature during the cycle of vegetation of Corn, that the anomaly, spoken of by Humboldt, if it really exist, must be referred. The mean annual temperature of Xalapa being, according to him,† 64.77 F., while the thermometer sinks in winter, according to the same authority, from 59° to 57°.25 F.

The mean temperature of the half year, from May to October, both inclusive, as deduced from the daily mean computed from the Register of Observations for that period, kept at Xalapa by Col. Dashwood, and inserted by Capt. Lyon, R.N. in the 2nd Vol. of the Narrative of his Tour in Mexico, page 194, does not exceed 68°3333,* or little more than 2° of Fahrenheit's scale above that of the cycle of vegetation of Corn in the N. of Europe; while it falls short, by more than 13½ of the same scale, of that of the same cycle in Barbary and Egypt, countries so celebrated, both in ancient and modern times, for the abundance and excellence of their harvests.

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* Political Survey of New Spain.

† De distributione geographica Plantarum, secundum cœli temperiem, et altitudinem montium Prolegomena,—p. 110.

From these facts it appears sufficiently clear, that if Wheat fail to produce ears in the vicinity of Xalapa, as Humboldt states, some other cause must be sought than either latitude, climate, elevation, or temperature—since it is nearly a degree and a half to the N. of the centre of Jamaica, where wheat has been proved to yield an abundant return, not only from 320 to 2,320 feet nearer the level of the sea, but even at elevations hardly exceeding it, and with a temperature infinitely above that of the hottest months at Xalapa†; and this cause will probably be found to arise as much from the constitution of the soil as the redundant humidity of the air.

But, whatever might have been the case at the time of Humboldt's visit, (now nearly half a century ago,) we learn from more recent travellers, that some alteration has taken place in this respect since that time, or else that *all* the Cerealia do not possess the refractory character imputed by him to Wheat. Mr. Bullock, in the highly interesting account of his visit to Mexico, in 1820, nearly a quarter of a century later than Humboldt, acquaints us that he saw "good green Oats in the "neighbourhood of Xalapa; but never saw them given to horses in a "dry state."‡ From page 429 of the same work, we learn, that in the delightful neighbourhood of Themascaltepec, (of which Mr. Bullock speaks in terms of the highest rapture), "In the *same* field may be seen "the *finest European Wheat*, plantations of *Sugar Cane*, and fences of "*Agave Americana*:" thus furnishing an additional proof of the practicability of cultivating these apparently incongruous objects in the most perfect juxtaposition of soil, of climate, of temperature, and of season; affording presumptive evidence of the probability, at least, of accomplishing in the plains of the Antilles what had succeeded in the fields of Themascaltepec, the vallies of Aragua, and the district of Quatro Villas.

Before I proceed to notice the modern experiments made in the islands

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* The following Table exhibits the mean temperature of these months, observed at three several periods of the day by Col. Dashwood, to which I have added a fourth column, exhibiting the daily mean in each month, deduced from the Colonel's observations.

MONTH.	6 A.M.	NOON.	8 P.M.	DAILY MEAN.
May	69°	73°	71°	71
June	67	70	69	68.6666
July	68	72	69	69.6666
August	68	72	70	70
September	65	68	68	67
October	62	65	64	63.6666
Mean	66.5	70	68.5	68.3333

† In the plains of Vere.

‡ Bullock's Six Months in Mexico, ch. xxv. p. 241.

of the West Indies, I may be pardoned for briefly stating the result of trials made with the Victoria Wheat in other quarters.

Through the indefatigable exertions of my friend Mr. James White, of Plymouth, the benefits of Sir Robert Ker Porter's munificence have been extended to a wide circuit of the globe, from Canada, to Hindostan, Australia and Tasmania. I furnished both Sir George Gipps and Sir John Franklin with ample supplies for the neighbourhood of Sydney and Hobart Town, but have received no reports from either place. More recently I furnished Captain Hobson with a considerable quantity for trial in New Zealand; and hope, when the time arrives, to receive a favourable report from thence. From Madras Mr. White had the satisfaction to receive a letter of the date of the 24th December, 1837, of which the following are extracts:—"The only reason I can give for "having so long delayed my acknowledgments is, that I was anxious to "communicate the result of several experiments that have been made "with the seed. I caused small quantities to be sent to the Mysore, "Coimbatoor, Salem, Bellary, and Guntoir, the several districts under "this Presidency in which Wheat is an indigenous product. The "*Golden Wheat*, I regret to say, from the extreme drought of the "season, failed everywhere; but the *Victoria Wheat* promises to "become a *most valuable addition to our stock of edible grains.* I have "only room to subjoin the following extract of a letter from Mr. J. D. "Orr, the principal collector at Salem, on the growth in that district: "'I have now *Victoria Wheat* enough to sow some acres, and I hope "'to have the seed in the ground by the 20th inst. (Oct. ?) By Feb. "'next you may have any supply of it you like from this district. The "'Ryots highly approve of it, and I was pleased to find some of them "'come and ask for seed. I know not what it may do at Victoria, but "'in India it does not come to maturity in less than three months and a "'half, in any trial I have given it.' We shall be most thankful to you "for a farther supply of this valuable seed, and for any other supplies "of the same kind that you may think useful for us."—J. S.

From the banks of Lake Huron, where the temperature of the cycle of vegetation of Corn fully equals that of the West Indies, Mr. White's reports are no less favourable. In a letter of the 23rd of September, 1838, his correspondent says, "I planted the *Victoria Wheat* in May, "and cut it some time in August; it is remarkably fine, though Spring "Wheat does not grow well in this country, generally speaking." And in a subsequent letter, dated Toronto, 15th Oct. 1839, the same writer observes, "I really think the Victoria Wheat would prove valuable here "*There is nothing the farmers are so much in need of as a good "description of Spring Wheat, for that sown in Autumn is continually. "failing.*"

CHAP. II.

MODERN EXPERIMENTS ON THE CULTURE OF WHEAT IN THE WEST INDIES.

Sect. 1.—*Jamaica.*

HAVING, through the patriotic zeal of His Excellency Sir R. K. Porter, Her Majesty's distinguished Minister at Caracas, been favoured with a supply of Wheat from the celebrated harvests of La Victoria, I transmitted a portion in August, 1834, to Dr. Bancroft, accompanied by a request that he would use his influence to obtain for it a fair trial, and correct reports of the result.

Although far from possessing at that period a tithe of the information I have since acquired, I was led to believe, from the statements already extracted from Humboldt, respecting the culture of Wheat in conjunction with the Cane, the Plantain, the Cotton, and other products of the hottest climates, that with a little patient attention, and carefully repeated experiments, the same object might be effected in the British islands, if not at as low levels as in Cuba, at least in the more elevated regions; and I was accordingly desirous of obtaining the results of experiments made at various elevations, and different seasons, for the purpose of determining the fittest season and lowest level at which its cultivation could be carried on with advantage.

Humboldt's statement respecting the failure of Wheat tillage at Xalapa, undoubtedly threw a shade of doubt over the hope of success in an island two degrees nearer to the line, and one in which the limits of cultivation did not attain an equal elevation; yet notwithstanding these disadvantages on the side of Jamaica, I thought the experiment at least worth the attempt there.

In the extract from Humboldt already given, at page 11, it is observed, that although " we know the *minimum** of heat requisite to ripen Wheat,

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* Humboldt, in his " Prolegomena de Distr. Geog. Plant." p. 160, explains this *minimum* as follows. " *Cerealia* [Triticum, Secale, Hordeum, Avena] coluntur cum " proventu, licet *calor medius annuus* infra—2 (28°.4 F.) descendat, si modo *æstivus* " inter 11°—12° (51°.8—53° F.) consistit. Quæe vulgo afferunt peregrinatores " de celeritate, qua Cerealia in summo septentrione, à germinatione usque ad fructum, " crescunt, recté non nisi de *Avenâ et Hordeo* dici possunt, nec de *Secale* atque " *Tritico*. In zonâ temperatâ v.c. Edinburghi, *Triticum* cum magno colitur " proventu, si per septem menses [20th Mar.—20th Oct.] temperies medius sit " 13° [54° 46 F.] Descendit autem sæpè *hujus tempestatis calor medius* ad 10°.5 " [50°.90 F.] et si esset vel *duobus gradibus* minor, jam *Hordeum, Avena*, cæteraque " Cerealia *non maturescerent*. In Alpibus maritimis, ut propè Allos Gallo Provinciæ, " De Candolle Secale usque ad 1100 hex.; Triticum usque ad 900 hexap. invenit."

"Barley, and Oats, we are less certain as to the *maximum* which these "species of grain, accommodating as they are, can support. We are even "ignorant of all the circumstances which favor the culture of Corn between "the Tropics at very small heights." This, therefore, was the problem which I proposed to myself for solution, and which I trusted the philosophic mind of the illustrious Bancroft would aid me in determining in the most clear and satisfactory manner.

The prejudice, however, of which Humboldt speaks, as prevailing with respect to the Cerealia, which have been supposed to be impatient of a high temperature and low latitude, prevented the first trials being made in any but alpine situations considerably elevated above the sea, enjoying a temperature closely resembling that of the warmer parts of Europe, and considerably below that of the less elevated situations occupied by agriculture in the smaller islands—a circumstance which detracted considerably from the usefulness of their results, and left the problem sought to be illustrated in a great degree involved in its original obscurity. This, however, has been fully remedied by later experiments both in Jamaica and other islands: which have fully disproved the opinion expressed by Humboldt in the passage already cited from his "*Prolegomena*,"* that "*all kinds of grain are impatient* "*of the equinoctial heats;*" assuming, without an attempt at demonstration, the conflicting examples of Victoria and the interior of Cuba to be exceptions in no respect invalidating the general rule.

How a mind so philosophic as that of Humboldt could be satisfied with a conclusion resting upon such unsatisfactory premises, it is somewhat difficult to understand; especially after his clear demonstration elsewhere,† "that *the augmentation of heat is not prejudicial to the* "*harvest of Wheat*, and other alimentary grain, unless it is attended "with an excess of drought or moisture." He might not unnaturally have asked himself why, if Wheat admitted of profitable culture at a level nearly corresponding with that of the Ocean, at 23° from the Equator, should it not succeed nearly, if not quite as well, at a similar elevation 5° nearer to the line, or on the N. side of Jamaica, corresponding so nearly in latitude with that part of the coast of Haïti on which Columbus found it succeed so well three centuries before? Does the inferior limit of Wheat, in approaching the line, ascend above the level of the ocean like that of perpetual frost? and if so, what is the nature of the curve so described? what the varying influence of the sun in his annual course through the zodiac? what the correspondence of this curve with the latitudes through which it passes? and what the extreme and mean limits of its variation with the advance and retrogression of the sun? These are questions which it might have been expected would have presented themselves to his enquiring mind, and to the solution of which he would have applied himself with the usual acuteness of his powerful understanding. Unfortunately for science, the circumstances of a traveller, never stationary in one spot for a sufficient time to pursue a protracted course of observation, prevented him from investigating the subject more profoundly, or determining with any thing like precision, the exact value to be attached to the popular prejudice which he adopts in one place, and condemns in another.

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* See page 6 of this Memoir. † Pers. Narr. vol. iv. page 111.

But the omission of Humboldt does not preclude us from entering upon the enquiry—an inquiry which involves in its consideration the best interests of our West Indian possessions. What then are the laws, or do any such exist, which govern the various contingencies requisite, according to Humboldt, to the cultivation of Corn within the Tropics? and to what extent, if at all, do these laws operate to the exclusion or modification of Wheat culture in the Antilles? If its success at low elevations in the interior of Cuba, and on the N. coast of Hayti, be the result of a cold current of air pouring down from the icy latitudes of N. America, why should not a similar effect result from the same cause, in perhaps a somewhat modified degree, upon the N. coast of Jamaica, not above 4½ deg. nearer the Equator than the one, and so nearly coincident in latitude with the other? The island of Cuba possesses, in the longitude of Jamaica, no elevations of height or extent sufficient to intercept much, if any, of this polar current in its progress to the South, while the space of little more than 3° of ocean which intervenes can have but small effect in raising its temperature. The lofty ridge of the Blue Mountains, with an elevation of from 5 to 7,000 feet and upwards, with the somewhat less lofty ridge which screens the plains of Vere from the chilling currents of the N., might be expected to present a much more influential barrier, and exert a much more prejudicial effect upon the culture of Wheat; yet we shall presently see, that these very plains, dry and burning as they are, offer a field for the growth of Wheat as favourable as the mountains of St. Ann, or St. Andrew's, or even the more northerly district of Quatro Villas.

On comparing the surface of Jamaica with that of Cuba, we find that it is only the Eastern part that can strictly be called mountainous. In Cuba the mountainous region is confined, almost exclusively, to a space of about 3° of longitude in the S.E. quarter, from Punta Maysi in the E. to Cabo Cruz in the W., corresponding nearly in longitude with Montego Bay, on the N. side of Jamaica. None of the heights in this district have been determined by actual admeasurement; but the elevation of the Sierra del Cobre, or Snake Mountains, has been estimated to reach to 7,200 feet at its highest point. However, snow has never been seen either upon this ridge, or upon the Loams of San Juan, farther W., the elevation of which has been computed to be 1800 feet. Hail storms are also rare, seldom occurring above once in 15 or 20 years; and then only with the wind from SSW. With the exception of this district, Cuba presents no continuous ridges, or elevations of any but the most moderate height.

The Eastern part of Jamaica is almost wholly filled by the Blue Mountains, of which the principal ridge, traversing the centre from E. to W. attains an elevation of from 5 to 6,000 feet, sending off numerous offsets to the N. and S. or NW. and SW. Of these, one taking a direction to the NW. presents three peaks of greater elevation than the rest, the highest and most northern of which reaches to 7,150 feet, or within 50 feet of the estimated height of the Sierra del Cobre. To the W. of the Blue Mountains, those which enclose the plains of Liguanea and Vere, attain an elevation of about 2,000 feet, rarely reaching to 3,000. Farther W. the mountains continue to decline in height; but still the Western end of Jamaica possesses a more decidedly mountainous character than the corresponding portion of Cuba.

With respect to climate a considerable difference exists between the two islands, and is most perceptible during the winter months, when the temperature sinks at the Havannah to 60°, or even to 55° ;* while at Kingston it never falls below 68°, or 69°. This difference arises, however, from the different position of the two capitals: the Havannah standing on the N. side of Cuba, open to the unbroken influence of the Arctic current, while Kingston, reposing at the Southern base of the Blue Mountains, is completely screened from its operation. Such is the effect of this current in Cuba, that at elevations of only 300 feet, (considerably, however, above the wheat district of Las Quatro Villas,) thin ice is frequently seen after a long run of northerly winds: a phœnomenon unparalleled at nearly seven times that altitude in Jamaica. The mean annual temperature at the Havannah is 77^b, or, according to Humboldt, 78°.4†; that of the hottest month rarely exceeding 84°, or that of the coldest falling below 70°. Occasionally, however, it has ranged from 94° to 55. At times, the changes have been sudden and violent; a fall of 15° having been experienced in the short space of three hours. In Jamaica, the mean temperature of the six summer months (May to November) is 80°, and the rest 75°. The maximum ranges from 96 to 100°; while the greatest cold in winter rarely depresses the mercury below 69°. These remarks chiefly apply to the low country S. of the central ridge. At elevations of 1000 feet, the mean summer temperature does not exceed 75°: that of winter being about 5° less; the mercury occasionally however sinking to 55°. For the temperature at greater heights, I am without data for calculation; but, assuming a decrease of 5° for every thousand feet, which is at the rate of the first thousand, we shall have for the mean Summer temperature at 2000 feet 70°, at 4000 feet 60°, and for the mean winter temperature at the former 65°, at the latter 55°.

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* Such a reduction is never known in Jamaica than at a lower elevation than 1,000 feet, and but seldom even there. Kirwan, in his valuable "Estimate of the temperature of "different Latitudes," Lond. 1787, says, at page 46, that "All countries lying to "*windward* of high mountains or extensive forests, are *warmer* than those lying to "*leeward*, in the same latitudes;" and adds, that "Countries that lie *Southward* of "any sea, are *warmer* than those that have the sea to the *South* of them, at least in "our hemisphere." These rules cannot, however, be regarded as applying to the Antilles, where no mountains reach even to the inferior limit of perpetual snow, and where they act, when their direction is, as in Jamaica, from E. to W., as *barriers* against the cold currents from the N. Hence, we find Kingston, in lat. 18°, to the N. of the sea, and *under the lee of the Blue Mountains*, warmer in proportion to its difference of latitude, than the Havannah, in lat. 23°. 8, which has the sea open to the N. *and no high mountains to leeward* of it. The difference of temperature proportionate to that of latitude should amount, according to Kirwan's table, only to 3° in July, and 4°. in January: while the actual difference amounts in July to 12°, or even 14°, and in winter reaches sometimes even to 20°. These anomalies are to be accounted for wholly from the interposition of the Blue Mountains, and their direction from E. to W.; in consequence of which the climate of the N. side of Jamaica is considerably cooler than that of the S. side; whereas, upon Kirwan's hypothesis, the reverse should be the case.

† "Havana, lat. 23°.8′; calor med. annuus 25°.6 (78°.44.F.); mensis calidissimi "28°.5 (83°.11.F.); mensis frigidissimi 21°.1 (69° 98.F. Interiora Insulæ Cubæ, "alt. 50—80 hex. (319.725—511.56 pedes); cal. med. annuus, 23° (73°.4.F.); mensis "Dec. vix 17° (62°.6.F.) Minuitur interdum calor usque ad 8° (44° 4.F.); rarisimê "spirante Boreâ, vel usque ad punctum congelationis." De Distr. Geogr. Plant. p. 108.

The spring rains commence in Jamaica about the middle of April or beginning of May, after the return of the sun to the northern hemisphere. At this season, however, the rains are usually partial, and descend in showers only. On the S. side especially, the dry weather commonly lasts till June, when the most violent rains commence, accompanied by an oppressive state of the atmosphere, and severe thunder and lightning, and continue more or less for about two months. The autumnal rains in Oct. and Nov. are seldom attended with thunder and lightning, and are less violent than the vernal, but are often accompanied by sudden and violent gusts of wind. As in Cuba, snow has never been seen on the most elevated points, although, in such situations, hail is said to be not uncommon; melting, however, almost immediately. The sea breeze, which sets in about 9 A.M., has a considerable influence in tempering the heat of the lowlands near the sea.

Having premised this hasty sketch of the surface and climate of these two islands, I shall proceed to Dr. Bancroft's interesting letter of the 9th of July, 1835, in which he says—"As you express, in your late letters, "a desire to be informed as to the growth of various plants which you "have been the means of introducing here, I will now proceed to give "such particulars of several of them as I have been able to collect up "to the present time."

"VICTORIA WHEAT.

"The Jamaica Society have received samples from three or four "different places, of the wheat produced there, *all of which appear to "be of a favourable sort.*

"First, from the mountains of St. Ann's,* where the seed has been "*sown the latter end of January and the corn was ripe the latter end "of April.* In another part of the same district, the dates of *sowing* "differed, but the wheat *ripened* in nearly the same period."

"Next from the mountains of St. Andrew's.† On one property FAIR "HILL,‡ the *sowing* and the *ripening* happened at the same dates as in "the first mentioned case. Of this corn, ONE GRAIN produced 28 "EARS, containing altogether 1500 GRAINS (being an average of 53 "grains for each year.) Notwithstanding this apparent success, the "proprietor of the place *thinks it unlikely* that the planters *would grow "the Victoria Wheat in preference to the Great Corn,* as it is called "here; i. e. Zea Mayz. On another plantation again,§ CHARLOTTEN-

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* The parish of St. Ann is on the N. Side, between St. Mary's to the E. and Trelawny to the W. and between the parallels of 18° 10′ and 18° 25′ N. The elevations above the sea are not given.

† The parish of St. Andrew, containing the town of Kingston, is bounded on the N.W. by a small portion of St. Mary's parish; on the N. by St. George's; on the E. by Port Royal; on the S. by Kingston harbour, and on the W. by St. Catherine's and St. Thomas in the vale; extending from about 17° 59′ to 18° 13′ N. lat.

‡ About 2,000 feet above the sea. At this elevation, and those still higher, the temperature sometimes descends in winter as low as 48° Fahr.

§ About 4,000 feet above the level of the sea.

"BERG, the seed was sown *early in March*,* and received a top "dressing; in the course of a few days it had sprung up three inches "above the ground; and, as *favourable and moderate rains* continued to "fall subsequently, the corn throve well, and *ripened it the early part of* "*June*, producing *abundantly* grain *of a larger size than the parent seed*, "the ears being large and full. Six of these, for instance, yielded 336 "grains, weighing half an ounce to each ear. Mr. W. B. King, an "Assistant Judge of Assize, and a Member of Assembly, has since sent "me two bundles of the ears of his Wheat, and I intend to inclose one "or two of them as a specimen of the produce of the Victoria Wheat "here. From the trial just made, Mr. King has *no doubt* that *the grain* "*could be cultivated in many parts of this island*, and that it might "become a profitable resource."

Such were the results of the first modern attempts to cultivate wheat in the West Indies; results which, having been obtained under the immediate auspices of so learned and accurate an observer as Dr. Bancroft, merit the greatest weight and consideration. They do not indeed throw any new light on the problem of the minimum of elevation, or the maximum of temperature, nor do the reports furnish all the details we could wish; they afford, however, a practical demonstration of the unsoundness of the popular prejudice; and prove that Wheat may be produced at elevations above 2,300 feet lower than Xalapa, and yield its harvest in Jamaica no less than in Cuba. These were points of no small importance to be gained. This was a successful irruption into the field of antiquated prejudices, requiring only to be followed up with vigour, to yield results yet more important. In order to attract attention to the subject, I hastened to communicate Doctor Bancroft's report to the public, in a short paper inserted in the West of England Journal, published at Bristol, in 1835; copies of which I lost no time in circulating both at home and in the West Indies.

Soon after the return of the Marquis of Sligo from Jamaica, I wrote to his Lordship, urging a trial of the cultivation of Wheat upon his Lordship's property in that island; and at his suggestion, transmitted an ample supply of Victoria Wheat through Dr. Bancroft to the Hon. A. Bravo, a member of Council, a gentleman of large property, and an enterprising spirit, whom the Marquis represented as likely to give the Wheat a careful and impartial trial upon estates which he possessed at considerable elevations above the sea; and where, consequently, his Lordship, participating in those prejudices respecting the incompatibility of a tropical climate with the culture of the Cerealia, from which even the philosophic mind of the illustrious Humboldt was not wholly free, imagined the chance of success to be greater than in the lowlands. I accompanied this supply by a letter of the 6th of December, 1837, in which I strongly urged a trial in low as well as in alpine situations, requesting an accurate register of facts might be kept and communicated to me, free of postage, for the information of the public. In due time a bulky letter closely written, bearing the Kinston post mark, and containing no doubt, the important information I requested, reached me not post free, but saddled with so preposterously outrageous a charge, as amounted to a virtual prohibition of release; I constantly refused it, and thus, through the mischievous operations of the late Post Office regulations, the public lost the benefit of Mr. Bravo's information.

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* This period seems to have been judiciously selected, since the spring rains, which usually commence in April, and are far less violent than those in June, must have had a most beneficial effect upon the young plants, and the dry weather in May proved equally serviceable in ripening the crop before the June rains. Wheat sown on the 2nd of March should be fit for cutting on or before the 31st of May.

No farther intelligence respecting the progress of Wheat tillage in Jamaica, reached me either from Dr. Bancroft, or any other individual, prior to the 5th of May, 1839; when I received a file of the St. Christopher Advertiser, one of which, of the preceding March, contained a paragraph of which the following is a copy:—

" JAMAICA. *Victoria Wheat.* The following reasons in favour of
" the cultivation of Wheat in that island, are by John B. King, Esq.
" of St. Ann's: we extract them from the proceedings of the Old
" Harbour Agricultural Society. ' First, the simplicity of its cultivation;
" ' *remaining on the ground so short a time,* three months; requiring *so*
" ' *little attention,* and liable to so few contingencies. Second: *its*
" ' *importance as an article of food.* Third: on account of its not injur-
" ' ing the English agricultural interest, because Wheat and Flour are
" ' extensively imported into England, and *almost the whole of our island*
" ' *supply is foreign.* Fourth: on account of its value as a crop, and
" ' the ready market it meets. And lastly: on account of its supplying
" ' permanent employment to a large portion of our population in the
" ' mountain districts, in a way that is not strange to them.'

" *Oats.* Mr. King, speaking of *Oats,* says, ' they have succeeded
" ' beyond my most sanguine expectation, and are about the same time
" ' as *Indian Corn** in coming to perfection. The sample I procured
" ' for seed was kiln dried for the Tropics, and consequently, from a
" ' large handful, I succeeded in obtaining but a few plants: each seed
" ' threw up an amazing quantity of stems. To make up for the loss of
" ' seed, *I took up the few roots when about* 3 *weeks old,* and *divided*
" ' and *transplanted them,* by which means I obtained about 10 plants
" ' from each seed: each plant threw up from 25 to 30 heads, each head
" ' containing from 50 to 100 seeds, so that taking the smallest numbers,†
" ' 25 and 50, makes 1250 grains each plant, or nearly 12,000 fold.

" *Barley.* Having given the result of his experiment on Wheat and
" Oats, Mr. King next alludes to the growth of *Barley.* ' I have no
" ' doubt', he says, ' Barley would succeed better than either, but I
" ' could not obtain the seed here, but expect some shortly from England."

Finding from this extract, that the interest, which the experiments previously recorded, were so well calculated to awaken, had not, as I feared, become extinct, but was still alive and progressively increasing, I resolved to avail myself of this happy circumstance to promote the culture of the Cerealia to the utmost: and with this view wrote to Dr. Bancroft on the 8th of May, 1839, by the Pigeon Packet, inclosing samples of the

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* *Zea Mays;* Great Corn or Maize.

† If in place of the smallest numbers, we take the means, we shall have an increase of $1 \times 10 \times 27\frac{1}{2} = 275 \times 75 = 20{,}625$., grains for 1. The highest numbers gives an increase of 30,000 for one.

Eclipse and other Wheats, and promising a supply of Barley and Oats, for Mr. King's farther experiments, as soon as I could obtain them. This promise I was unable to redeem before the 23d of July, when I transmitted a small portion of each, by the Petrel Packet, accompanied by specimens of Teff and Adja.*

On the 15th of July, 1839, along with a box of Wheat of the harvest of the preceding February, I received a letter from Sir R. K. Porter, of the 6th of May, covering the last half of a number of the Grenada Free Press, in which was the following extract from the Jamaica Papers, which furnished the first conclusive evidence of the fact I had been so long labouring to establish, namely the practicability of cultivating Wheat at levels little exceeding that of the sea, to the Southward of Cuba.

" VICTORIA WHEAT. This Wheat, it appears, has been cultivated " in this island, with success. The President of the Agricultural " Association, speaking of it, says :—

" ' I have great pleasure in reporting to the meeting the result of three " ' experiments, made under the auspices of the Society in respect to the " ' Victoria Wheat which was placed under the care of this Society by " ' Dr. Hamilton, through the assistance of the Marquis of Sligo, and Dr. " ' Bancroft. I cannot resist my inclination to refer to the fact, that the " ' cultivation of Wheat has kept pace with the civilization of man ; and " ' may be traced from the sunshine of the S. to the darkness of the N. " ' of Europe ; keeping pace with the march of improvement, and the " ' cultivation of letters. This reflection leads me to a remark upon *a singular coincidence*, namely, the *arrival* of this Wheat, its *cultivation*, " ' and *its first fruits* being reaped in Jamaica, *at the very period of the* " ' *extinction of that remnant of barbarism, the Apprenticeship* system. " ' You may not, Gentlemen, be disposed to regard this in the same light " ' as I do, as a *happy omen in the times* ; but you must admit that it " ' presents to you *a new æra in the employment of labour* in the country, " ' in the cultivation of an article which constitutes the principal food of " ' civilized man : particularly if future experiments should confirm the " ' important expectations which may be fairly founded upon the reports " ' which I now present to you. This happy, splendid, peculiarly " ' favoured little Parish [St. Dorothy's†] may boast of its GUINEA " ' CORN ‡ ; but we must recollect the *precarious* and *uncertain* " ' cultivation of that grain ; and (do your best) *it will give but one crop* " ' *in the year* ; whereas the VICTORIA WHEAT promises 3 if not 4

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* The seed sent under the name of *Teff*, is not that I believe that of the *Panicum Teff*, or true *Teff* of Abyssinia, but the *Poa Abyssinica*. The *Adja*, according to my friend Professor Desvaux, is the *Triticum Spelta*.

† A very small parish, bounded on the N. by St. Johns ; on the E. by St. Catharine's ; on the S. by Old Harbour ; and on the W. by Clarendon, by a narrow tongue of which running down to Old Harbour it is separated from the N.E. extremity of Vere.

‡ The *Holcus Sorghum*, or Guinea Corn, is, as its vernacular name implies, a native of Africa, which, having been introduced at a remote period, has almost become naturalized in the West Indies. It should be planted according to Lunan [Hort. Jam. 1 p. 352] between Sept. and Nov. and is ripe in Jan. or Feb., or in from 4 to 5 months ; *but is said not to be productive at any other season of the year*. Being very impatient of cold, it thrives only in the warm lowlands, in which it is extensively cultivated in all the islands, yielding a return in rich soils, of from 30 to 40 bushels per acre.

" ' crops annually ; and seems to grow *equally well* in the *arid plains* of
" ' VERE, and the *humid mountains* of CLARENDON and ST. ANN'S.
" ' The Wheat produced in VERE, was planted at *Hill Side Estate*,
" ' on the 22nd March last : it *came up on the 27th* (5th day): the first
" ' ears came out *on the 9th of May* (58th day): it *began to ripen on the*
" ' *6th of June* (76th day) : and was cut on the 20th (90th day) and
" ' might have been cut a day or two earlier but for the frequent rains
" ' which made it too wet to be taken in. The portion sown in CLA-
" ' RENDON† was on *Mount Moses Plantation* ; it was *planted in*
" ' *March and reaped in June.*
" ' In ST. ANN'S,‡ Mr. King *planted it on the* 30*th of March* ; on
" ' the *2nd of April* (3d day) *it was up*, and continued to grow very
" ' fast. In about 2 *months* from the time of sowing, it began to show
" ' head, and blossom, and improve ; *on the* 30*th June* (92nd day) *it*
" ' *was quite ripe* and full, and decidedly equal, if not superior, to the
" ' sample sown. The only attention it received was once weeding
" ' between the drills which proved quite sufficient.' "

Such is the report of the enlightened President of the Agricultural Association, the more valuable from its presenting something like a precision of dates which enables us to follow the experiments with more ease and satisfaction through their several stages ; from its furnishing the first recorded instance of the successful cultivation of wheat, at so low a level and in so low a latitude, since the days of Columbus ; and from its exhibiting a retardation of two days in the ripening of the crop in St. Ann's, resulting either from the difference of elevation, or the period of sowing.

Sect. II.—*Bahamas.*

Soon after the receipt of Dr. Bancroft's highly gratifying report of the first trials of the cultivation of Wheat in Jamaica, I availed myself of the opportunity presented by a correspondence unexpectedly opened with the zealous and indefatigable Secretary of the "Bahama Society for the Diffusion of Knowledge"§ the Hon. J. C. Lees, H. M. Chief Justice, to extend the range of trial, and, if possible, convert the extensive and comparatively unproductive Archipelago of the Bahamas into a fertile granary for the supply of our more Southern colonies.

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[*] A maritime Parish, bounded on the N. by Clarendon ; on the E. by Old Harbour, and a tongue of Clarendon which divides it from St. Dorothy's ; on the S. by the sea ; and on the W. by St. Elizabeth. The Western part is hilly.

[†] A midland Parish, touching the sea only at one narrow point which stretches in the form of a tongue, between St. Dorothy on the E. and Vere on the W., to Old Harbour. It is bounded on the N. by St. Ann's ; on the E. by St. John's and St. Dorothy ; on the S. by Vere; and on the W. by St. Elizabeth, and a small portion of Trelawny.

[‡] A maritime Parish, on the N. side of the island, bounded on the N. by the sea ; on the E. by St. Mary's ; on the S. by St. Thomas in the vale, St. John's and Clarendon ; and on the W. by Trelawny.

[§] This Society owed its origin to the generous exertions of the then Lieut. Gov. Sir W. M. G. Colebrook ; with whose removal to the more important government of the Leeward Islands, it unhappily fell to the ground, before it had succeeded in effecting any permanent good.

Accordingly, I transmitted to that gentleman, on the 1st of September, 1825, a small portion of Victoria Wheat; repeating the supply on the 21st, when I sent him a copy of the paper detailing the Jamaica experiments: and dispatched to him, at various intervals, farther supplies of Victoria and other descriptions of Wheat.

Previous, however, to entering into the details of experiments, it will be proper to give such an account of the soil and climate of the island in which they were made, as I have been able to collect from the letters and journals of my active and intelligent correspondent.

New Providence, the theatre of these experiments, is situated about 35 miles to the W. of the centre of the long and somewhat semilunar island of Eleuthera, which embraces, as it were, this and an infinity of smaller islands, within its bosom, and protects them from the swell of the Atlantic. It occupies, in its greatest extent from N. to S. about 15° Lat. and about 23° of Long. from E. to W.; between the parallels of 24° 50′ and 25° 05′ of N. Lat. 77° 12′, and 77° 35′ W. Long. It is consequently about 1° 35′ beyond the Tropic of Cancer. Nassau, the capital, is in 25° 05′ N. and 77° 22′ W. Like all the rest of the group, N. Providence is low throughout its whole extent, presenting nothing in the shape of a hill, and destitute even of a rill of water. The mean temperature of the Summer months, from May to October, both inclusive, is said by Mr. Lees to be about 87° F., scarcely varying 2° or 3° either way, falling perhaps 2° lower at night. In February, according to Mr. Butler, the Thermometer has been so low as 59°, while its usual range during the months of March and April,* is from 70° to 80°.

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* From a register of the weather kept during the months of Sept., Oct., Nov., and Dec. 1836, at an elevation of less than 10 feet above the sea, I have extracted the following summary; which may serve, in the absence of more copious materials, to aid in forming something like a correct estimate of the climate:—

Year 1836	TEMPERATURE.			ATMOSPHERIC PRESSURE.					WEATHER.					Total No. of Obs.
Hour of Obs.	A. M. 7	NOON 12	P. M. 9	A. M.	P. M.	Mean Mouthly			Clear	Cloudy	Rainy	Squally	Hazy	
No. of Obs.	121	102	110	110	84	Maximum	Minimum	Oscillation	Obs.	Obs.	Obs.	Obs	Obs.	
Month														
Sept.	80.5633	84.5384	82.5833	30.0426	30.0582	30.1200	29.940	.180	33	17	32	22	..	104
Oct.	76.8065	79.9630	78.7586	20.9686	29.9505	30.1000	29.7450	.355	86	18	18	11	..	133
Nov.	72.2667	75.0370	73.1111	30.0655	30.0642	30.1950	29.960	.235	102	7	9	3	1	122
Dec.	70.8333	73.5912	72.4333	30.1320	30.1255	30.2600	29.975	.285	103	19	2	..	..	124
Mean	75.1174	78.2824	76.7203	30.052175	30.0496	30.16875	29.905	.26375	324	61	61	36	1	482

DIRECTION OF THE WINDS.

Year 1836 Months	E. side of the Compass.				W. side of the Compass.				N.	S.	Variable	Calm	Total
	Due E Days	N. of E Days	S. of E. Days	No. of Obs.	Due W Days	N of W Days	S. of W Days	No. of Obs.	Days	Days	Days	Days	No. of Obs.
Sept.	25	24	19	68	1	..	..	1	..	2	2	16	89
Oct.	4	41	4	49	2	18	15	20	9	6	..	8	92
Nov.	13	27	9	49	..	18	4	22	7	5	..	7	90
Dec.	18	32	11	61	..	8	5	13	6	6	..	4	90
Total	60	124	43	227	3	39	14	56	22	19	2	35	361

From the table given in the note, an estimate may be formed of the mean annual temperature of N. Providence, which will not err much from the truth. According to Humboldt, half the temperature at sun rise and at 2 P.M. represents very nearly the mean temperature of the day; while the mean temperature of April and October nearly corresponds with that of the entire year. Our information is unfortunately deficient with respect to the observed temperature of April. The mean temperature of October, however, having been 78°,2427, we may not unfairly assume, upon Humboldt's hypothesis, the mean temperature of the year to vary little from 78°. Kirwan assigns to the Lat. of 25°, a mean monthly temperature for April, of 74°.5; and for October of 73° 5, which would give 74° for the mean temperature of the year; 4° below the mean temperature of October, according to Mr. Lee's Journal, but corresponding very nearly to the mean annual temperature of the lat. viz. 73.958333 deduced from the monthly mean temperatures assigned to that lat. by Kirwan. This, however, is undoubtedly too low, unless we suppose the temperature in Mr. Lee's observations to have been raised above its proper level by local or accidental causes. The cycle of wheat culture may be taken to commence in December and end with May; but we are without sufficient data for computing its mean temperature. From the data furnished by Kirwan, it would appear to be about 70°8, or 71; but this table being calculated for latitudes at sea, gives results below the observations on land. It is not improbable that the mean temperature of the half-year I have named, considerably exceeds 75°.

New Providence suffers much, at some seasons, from excessive drought, and at others from the amount and impetuosity of the rains; these descend in torrents in May and September, washing away the soil from every declivity, and hurrying along with them to the sea, every thing incapable of withstanding their fury; thus doing much, and often irreparable mischief. These are followed by a period of drought as pernicious, in the opposite extreme as the rains. "The stratum of soil is so thin," as Mr. Lees observes in his letter of the 8th of August, 1836," *and so little* "*retentive of moisture,* that it shortly dries down to the very rock, "destroying every thing which cannot do without moisture, or which has "not strength enough to send its root downwards into the cracks and "fissures of the rocks.

" *Where the wheat is grown is not more than 4 feet above the sea level.* "The soil is of three kinds: *a red soil* composed of wood and other "vegetable matter, which, *at first,* is exceedingly fertile, and is the best "land for Pine Apples; but, when exposed, is very soon exhausted; "and, indeed, in dry weather, is so very fine and light that it soon blows "away, leaving the bare rock, which is *every where* in these islands "*from 6 inches* to 2 *feet* under the stratum of soil. There is a *black* "*vegetable mould of the above nature,* but *not so fertile*; and there is "a soil (by far the most abundant) composed of pulverized Madrepore "rock and minute fragments of shells interspersed with either or both "of the above vegetable moulds: this of course may be much improved "by adding animal manure to it. It was in the latter, *so improved* "*with animal manure,* that the Wheat I now sent was grown. The "sea sand is entirely pulverized shells, with the exception of some "curious sand, composed of round or oval particles* (a specimen of "which I take this opportunity of sending to you). We have *no rivers*, "or *ponds of any description*, all our water being obtained from wells. "Artificial watering is therefore out of the question, except in very "small gardens. *The ground is so rocky* that no where could a "plough, or even a spade be used: the hoe is the only instrument "of which we can avail ourselves. From what I have stated, you will "see that we are not very likely to do much in the agricultural way".†

The difficulty of irrigation during the dry season, of which Mr. Lees complains, is one which might be overcome by some little outlay of labour, money, and ingenuity, expended in the formation of large tanks or cisterns for collecting and retaining the redundant rain precipitated during the rainy months, from which it might be distributed, on the return of the dry season, by pumps worked by small windmills such as those employed in the Salterns about Lymington. By intercepting the channels for conveying the rain water into these tanks, with deeper and wider expansions, in which the stream, by losing its velocity, might deposit the earthly impurities with which it is loaded, before entering the tanks, much of the soil which would otherwise be accumulated in them, might be intercepted, and the frequency of cleaning the tanks out greatly diminished. Such contrivances are frequent in Nevis, where they are familiarly known by the name of "*Mould Traps*". These tanks should be lined with some substance capable of preventing the filtration of the water through the porous rock which forms the substratum of the islands: for this purpose no better substance can be found than the volcanic earth known at Nevis (where it is employed for a similar purpose) by the name of *Terras* or *Tarras*, which might be beneficially exchanged for the calcareous sand already spoken of, and thus form a profitable object of traffic.

But to return from this digression. In a letter of the 1st of September, 1835, covering a copy of Dr. Bancroft's valuable report, and containing a request that Mr. Lees would use his influence with the members of the Bahama Society to obtain a fair repetition of the Jamaica experiments, I sent a few grains of original Caracas seed, and some, the produce of Caracas seed raised in a garden in Plymouth, together with some English Red and White Wheat, for the purpose of comparison. The results are given in the 10th and following numbers of the "Journal of the Bahama Society for the Diffusion of Knowledge" as follows.

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* This sand dissolved with effervescence in Hydochloric Acid, without leaving any residuum, thus shewing that it consists wholly of Carbonate of Lime. It derives its origin most probably from the detritus of the coral reefs which surround and form the basis of the islands, worn smooth and rounded by long attrition. This sand would be a valuable addition to the soil of Antigua and other islands, into the natural composition of which lime enters but sparingly. Hence, probably, it will one day become a lucrative object of commerce, when the culture of wheat has been fully established, and the intercourse between the islands facilitated by a more extended use of steam.

† Nineteen grains of the Wheat here spoken of weighed 10 troy grains, being at the rate of 114 to the drachm, or 13,000 to the lb. avoirdupoise. The average of the Caracas seed is 136 to the drachm, or 15,867 to the lb. of 7000 grains. This may be attributed to the joint operation of the calcareous constituent of the Bahama soil, and the animal manure. A bushel of this improved wheat should weigh about 59-06lbs. Avoirdupoise.

" H. Excellency the Governor, Sir W. M. G. Colebrooke, K.H., then " made the following communication respecting the Victoria Wheat. " Two plants of Victoria Wheat, No. 3, sown on the 1st November, " being the seed of English growth, raised from Caracas seed, are now " shooting into ear.* No. 1, or English White Wheat, and No. 4, or " English Red Wheat, are not so forward, but look healthy: of the 1st " No. 3 there are 10 shoots for each seed sown. Mr. Lees stated that " he had been informed by John Storr, Esq., that each grain of the " Victoria Wheat which he had planted, would be likely to produce 100 " ears; counting only on the very moderate number of 50 grains to each " ear, this would be an increase of 5,000 per cent. or 5,000 bushels for " one. Mr. Storr intends planting a quarter of an acre with this wheat, " from which, no doubt, abundance of seed will be obtained."—p. 119 and 120.

To these brief notices of the first trials, is subjoined at p. 123, a tabular view of the general results; which, however satisfactory as dispelling the mists of prejudice, certainly disappointed me in the length of time required to bring the crop to perfection. The following is a transcript of this table, which presents results slightly varying from the notices already quoted:—

WHEAT.

" The following descriptions of Wheat, received from Dr. Hamilton, " were planted on the 1st. Nov.† in the garden attached to Government " House, Nassau, N. Providence, i. e.

DESCRIPTION.	
" No 1, English White Wheat	14 grains of which are come up, but not yet in ear.
" No. 3, Victoria Wheat, English " growth, raised from Caracas " Seed	6 grains: *all came up*, and have produced 62 stalks in ear, which are now ripening.
" No. 4, Red Wheat..	Came up and have produced 6 stalks, but not yet in ear.

" Account of Wheat planted at the same time by Mr. Storr.

" No. 1, English White Wheat	Not yet come up.
" No. 2, Victoria Wheat from " Caracas	Each grain has produced from 50 to 60 ears, each ear containing from 70 to 80 grains.
" No. 3, Victoria Wheat, English growth, raised from Caracas Seed	Same.
" No. 4, Red Wheat	Has spread much, having the appearance of grass, but has not yet produced any stems."

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* This was on the 12th of March, or 131 days from the date of sowing. We shall presently see that a much shorter interval is sufficient.

† The mean temperature deduced from Mr. Lee's diary was, for Nov. 73°4716, the mean of 84 observations: and for Dec. 72°.28593, the mean of 82 observations. The mean atmospheric pressure in Nov. 30.04323, deduced from 50 observations: in Dec. 30.0858, the mean of 52 observations. The highest temperature in Nov. was 80° at noon on the 12th and 14th, and the lowest 67, at 7 A.M. on the 27th, 28th and 30th. The highest in Dec. was 79° at noon on the 6th, with a moderate wind from S.E. and a clear sky; the lowest 63° at 7 A.M. on the 29th, with a clear sky and fresh breeze from N.

The last notice of these preliminary experiments, to be found in the Transactions of the Society, is that contained in the report of the proceedings at the Monthly Meeting on the 11th of March, 1836; of which a brief account appears at the close of the 11th number, page 137, where we learn that there were exhibited at that meeting "several ears of the "Victoria Wheat which had been produced in the garden of John Storr, "Esq. The Wheat was received from Dr. Hamilton, of Plymouth, and "planted in the beginning of Nov. last; each grain, it was stated, has "produced from 50 to 60 ears, each ear containing from 60 to 70 "grains.*"

These details, however satisfactory as far as they go, are unhappily deficient in that minuteness, which would enable us to form a correct estimate of the results. We must therefore be content with such an approximation to the truth as can be gleaned from the scanty materials they furnish. The first and most striking fact which arrests attention, is the wide difference of habit between the wheat usually cultivated in England, and that which has been acclimated by a naturalization of more than three centuries within the Tropics; and the inappreciable change effected by cultivation, for a single season in Europe: a difference of habit the more remarkable, and the more difficult of explanation, from its contradiction of the results, stated in the beginning of this Memoir† to have been obtained by Columbus with wheat direct from Europe. Possibly the closer approximation of the mean temperature of the cycle of corn in Andalusia, (whence, no doubt, Columbus's seed came) to thatof the season of his experiment in Hayti, may have had some influence upon the result: and point to the southern districts of Spain, as Andalusia, Granada or Murcia, or the hotter parts of Mexico, as the vicinity of Themascaltepec,‡ as the places from which, next to Victoria, Wheat should be obtained for culture in the West Indies. The mean temperature of the cycle of vegetation of corn in the southern parts of Devon approaches, however, like that of the North West coast of Spain, so nearly to that of the months in which the experiments were made in New Providence, as to awaken a suspicion that other causes than mere diversity of climate or of soil occasioned the failure of the Devonshire samples which has been just recorded; and suggest the propriety of repeating the experiment with every possible variation, in order to detect the secret of the cause and the degree of its permanence. That the failure of the White Wheat in Mr. Storr's experiments, must have been the result of accident, possibly of the depredations of insects, is rendered probable at least by the vegetation of the 14 grains planted by the Governor, although no notice is taken of their farther progress. The period of sowing, too, which was about the 10th day of the moon's age, and nearly 12 weeks earlier than that selected either in Haïti or Jamaica, is another circumstance which may have influenced the results.

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* Col. Le Couteur, referring to these experiments in a letter of the 5th Sept. 1839, observes,—"In Mr. Storr's experiments, though we have a great amount of tillering, "still we have no knowledge of the *weight of the bushel or that of the grain.* I wish "that you would have the goodness to ask *how many grains will weigh down a* "*scruple* Apothecaries weight? I have fixed on that weight, as it is likely to be met "with in all English colonies in medicine chests: and I have found varieties varying "from 18 to 44 grains to the scruple, and any weighing about 25 may be considered "good, and will weigh about 62lbs. to the bushel."

† See page 2. ‡ See Chap. 1. p. 20.

But the failure of the European, is more than compensated by the success of the Victoria Wheat, whether direct from Caracas, or reared from Caracas seed in Europe. The tillering in each case was the same and the produce alike; and though the actual return fell short of what the sanguine mind of Mr. Storr led him to anticipate, it was still sufficient to gratify the most extravagant cupidity, and more than bear out the opinion of Humboldt, already quoted,* as to the error of the supposed degeneration of the Cerealia on approaching the line, and the diminution in the amount of the return.

In New Providence, within 25° of the line, we find in the Governor's garden 62 ears from 6 grains, and taking the produce at 65 grains to each,† we shall have a total return of 4,030 from 6 grains, or 671.6666 from 1: a return far exceeding that obtained, *but at a vastly higher level*, in the fertile vallies of Aragua.‡ Considerable, however, as this return was, it falls infinitely short of that reported by Mr. Storr, who obtained from 50 to 60 ears, each containing from 60 to 70 grains from each seed: giving a mean of 55 ears from each grain, and 65 grains from each ear: amounting to an average return of 3,475 for one.

Nearly 12 months elapsed before farther intelligence arrived: at length a letter of the 30th of June, 1837, reached me from Mr. Lees, containing information of a less favourable character, but which might have been in some degree anticipated from the statements already quoted from his letter of the 8th of Aug., 1836.§

"Mr. Storr planted last January a quarter of an acre of Victoria Wheat "for experiment, and promised to keep a journal of the various points "of information you wish to obtain; but the small birds, of which there "are great numbers here, ate every grain of the Wheat, which was "*bearing abundantly*". Thus, the plague of the birds, as fatal to the hopes of the farmer as that of the locusts of old in Egypt, deprived Mr. Storr of his anticipated harvest, and robbed us of the valuable results of his labours. This was, however, a failure, in the production of which *climate, at least*, had no share; and one which might have equally followed, *from the same cause*, in the temperate fields of Devon, did not the English farmer, taught by experience, know how to guard against it. But, in a gentleman of the name of Butler, who unites to property and influence a competent share of agricultural knowledge, Mr. Lees was so fortunate as to meet with a more successful coadjutor, to whom we are indebted for the following report, the more valuable from the precision of its dates, which enables us to follow his experiment through all its various stages.

"My dear Sir—Annexed you have the result of my first trial of the "Victoria Wheat. I think it will yield a very large return annually, "and is well worth our attention in the Bahamas. My object is to "introduce it to the planters at Rum Key (about lat. 23° 37′ N.): the "success in the quarter I will hereafter communicate, and remain, &c.

"Hon. J. C. Lees." Robert Butler".

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* See chap. 1, p. 14. † The mean of Mr. Storr's latest report.

‡ Pers. Narr. vol. iv. p. 110, quoted at page 17. § See page 32.

"Six hundred grains of wheat were planted on the 31st of January, "1837, in the last quarter of the moon. *The soil was improved by good "sheep pen manure** and sifted sand (calcareous) planted in drills *rather "thick,* and the seed in the drills firmly pressed down. It *began to "come up on the 6th of February,* but was not all up till the 18th. On "the *27th of March it began to shoot out ears,* being 55 *days.* In 90 "*days,* on *the 1st of May,* the whole was cut in, being completely "dry, yielding nearly 1000 ears, containing on an average 40 seed "each, in all fully 40,000 grains. The weather in February was cold; "the thermometer was as low as 59°; in March and April ranging "from 70° to 80°. The period was a very dry one; hardly one third "the plants were watered once a day."

Taking Mr. Storr's average,† the 600 grains planted by Mr. Butler, the weight of which hardly could have exceeded .0488276 of an avoirdupoise pound, ought to have yielded at least 33000.8 ears, containing 2,145,050 grains, the weight of which, at 15,867 grains to the pound of 7,000 grains, should have been 135,195lbs. But from the sample of Bahama Wheat sent by Mr. Lees,‡ 13,300 grains weigh 1lb.; at which rate 2,145,050 grains should weigh 161.282 lbs. and measure, at 59.06 lbs. to the bushel, 2.73082 bushels, the produce of less than the 1209th of a bushel of seed: while the actual return did not exceed what might have been expected from 181 or 182 grains, planted sufficiently apart, to admit of tillering freely. This advantage appears to have been lost to a considerable degree by the seed being planted "*rather "thick*", which prevented the tillers from averaging more than 1.6666 for each grain: the closeness of the plants counteracting their natural disposition. The cold weather in February also, together with the extreme dryness of the whole period, co-operated, no doubt, in such a thirsty soil as that of N. Providence, in diminishing the amount of the return.

After another interval of about two years, Mr. Lees again favoured me with a letter dated Nassau, N.P., April 12, 1839, in which he expresses a decided opinion "that *the Victoria Wheat would produce well in this "climate,* and prove *a valuable article of cultivation.* I am sorry," he continues, "I have been unable to give you a more satisfactory account "of all that which you have so kindly taken the trouble of sending to me: "but unfortunately there could not have been a more unfavourable "period for making the trial than the whole time between that of the "first which you sent being planted, and the present". He then proceeds to explain the causes, not the least powerful of which was the fearful visitation of "*three severe hurricanes*", which annihilated the hopes of the farmer, sweeping his crop, together with the very soil in which it grew, into the depths of the ocean, and reducing the inhabitants to a state of the most deplorable distress. Having explained the causes which thus unhappily interfered with the satisfactory completion of his report, he proceeds as follows:—

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* Lord Western states in a letter to Lord Rayleigh, dated Felix Hall, 4th Sept. 1839, that he regards the droppings of sheep mixed with chalk, lime, and marl, as superior even to that of bullocks: while lime, as Col. Le Couteur very justly remarks,—"Is *one "of the most indispensible manures for Wheat,* imparting more whiteness to the straw "and *more fullness and weight to the grain,* than any other; *it moreover attracts "humidity from the atmosphere, and thus nourishes the roots.*" Hence the advantage of the dressing so judiciously employed by Mr. Butler may be easily understood.

† Page 34. Page 33 note.

"I now regret that I did not keep more of it myself, but I thought I
" should do more good by distributing it among the cultivators in the out
" islands, who promised to give it a fair trial, and furnish me with the
" results, but who *have not in any case done so*. I hope still, however,
" to be able to give you a good account of some of it. Immediately
" before the hurricane of last year, I planted *a gill of it*,* all I had left:
" as the bed in which I planted it was *all washed away*, I did not expect
" to see any more of it, but in a short time several plants made their
" appearance, and grew luxuriantly where they had been carried to.
" In the beginning of January the ears began to ripen, the Wheat having
" been then planted about 4 months. The weather was cold, and it did
" not ripen very quick, but about the middle of the month I found that
" the rats (of which we have great numbers here) had destroyed a good
" deal of it. I then gathered it in, although not quite as ripe as it
" ought to have been, and obtained about *a quart of seed*. Had *the*
" *greater part* not been lost by the hurricane *the increase would have*
" *been immense*. The quart of seed which I saved I have sent up to a
" small Pine Apple plantation, which I believe I before told you I had
" purchased on one of the islands called Eleuthera, about 60 miles E. of
" this place."

From this report we learn, first the singular productiveness of this grain, under circumstances the most disadvantageous: and next the importance of selecting the season for sowing in such a manner as to evade the perils of hurricanes or the risk of droughts. Had Mr. Lees dibbled in his seed sufficiently deep, and so timed his sowing as to have afforded the seminal roots time to spread beneath the surface before the accession of the hurricane, the plants would have been better prepared to resist the impetuosity of the torrents in their passage to the sea: while an inattention to this not only occasioned a loss of the greater portion of the crop, but produced a delay in the ripening of what escaped, the actual amount of which it would be difficult to estimate in the absence of precise data. Had the grain been planted at any period between Christmas and the middle of March, this misfortune would in all probability have been prevented, and an ample return obtained.

Sect. III. *Antigua and Leeward Islands.*

On the first receipt of Dr. Bancroft's report of the Jamaica experiments, I hastened to communicate the result, among others, to Sir E. J. Murray Mc. Gregor, at that time Governor of the Leeward Islands, together with one of the ears transmitted to me by Dr. Bancroft, in a letter written on the 12th of September 1835: and on the 13th of the following October, I addressed His Excellency again on the subject, inclosing a copy of the paper which appeared in the West of England Journal. But although from the channel through which they were sent, no doubt can be entertained of these letters having reached their destination, no notice has been taken of them by His Excellency to the present moment. By the removal of Sir W. M. G. Colebrooke to the Government of the Leeward Islands, a brighter opportunity, however, offered itself of obtaining a fair trial of the Wheat within the limits of his jurisdiction ; and thus making a farther progress in the solution of the important problem which has so long engaged my attention. What made me more confident of securing a favourable reception from Sir William, was the circumstance of his having witnessed the successful result of the trials made in New Providence, which must have removed any prejudice that might have previously existed in his mind. I therefore addressed His Excellency on this subject on the 27th of December, 1837 : accompanying my letter by a supply of Victoria Wheat for trial. Unlike his predecessor, I found Sir William animated with all the zeal for promoting the public welfare that could be desired. With a full determination to give the subject the full weight of his official influence, he sent round in spring (1838) " a supply of seed to all the " Presidents of the islands under his government, with a request that " it might be distributed to agriculturists, and gave directions for " planting." But, like my application to his predecessor in the government, Sir William's zeal found no corresponding response in the breasts of the gentlemen so addressed ; and in a letter of the 25th of November, 1838, he says " not a single report have I received."

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* Estimating a gill at the fourth part of a pint, or 4 ounces by measure, the quantity here planted could hardly have exceeded 3,966 grains: of this quantity 3 fourths, at least, must have been destroyed by the hurricane and rats conjointly, leaving but 992 plants at the outside: yet from these few plants a quart of seed appears to have been obtained. Allowing 32 ounces to the quart, we shall, without taking into account the probable improvement of the grain, have 31,733 grains or about 32 for one, an increase greater than could, under such circumstances, have been anticipated.

§ 1. *Antigua.*

In Antigua, however, an island whose inhabitants undoubtedly have the merit of being infinitely in advance of their neighbours in social and intellectual improvement, it was his good fortune to find a few individuals disposed to listen with patience to his suggestions, and at the same time possessed of the ability to act upon them.

Such, nevertheless, was the morbid apathy which, even here, pervaded the great mass of those whose interest might be presumed to have prompted them to endeavour to profit to the utmost by His Excellency's generous exertions, that up to the 14th of August, 1838, the only result which had reached him was " A small sheaf which Dr. Nugent gave me " yesterday, and which I herewith forward ; but I understand that Col. " Byam has also raised some ;" and he promised to use his endeavours to obtain from these gentlemen the details of their experiments. The sample here spoken of reached me along with His Excellency's letter ; and, although serving to demonstrate the fact of Wheat being as capable of forming ears in Antigua, as in Haïti, Cuba, Jamaica, and New Providence, or even in the temperate and fertile vallies of Aragua, (and consequently admitted of improvement there by the hand of art,) was by no means of such a quality as the results of the trials in Jamaica and New Providence had led me to expect.

In point of climate, New Providence, although about 3° farther from the line, differs little if at all from Antigua: for if, with Humboldt, the mean temperature of October be assumed as nearly the standard for the year, we shall have from 78° to 79° for the mean annual temperature of New Providence; but the mean temperature of October in Antigua, according to a diary kept in St. Peter's Parish, in N. lat, 17° 8' and W. long. 61° 48', between the 1st of Nov., 1836, and 1st Nov. 1837, appended to Dr. Nicholson's admirable sketch of the Topography and Statistics given in the Antigua Almanack for 1838,[*] and subjoined in the note, is 79°.7, and the mean temperature of the entire year 77.8 or 1° below the mean temperature of October in N. Providence. The temperature of February indeed fell, as Mr. Butler informs us, to 59°, or 8° below the minimum at Antigua, and no less than 12°.7 below the mean given in the table in the note; but so far does this appear to have been from favouring germination, that it actually retarded the appearance of the greater part of the plants for at least 12 days: 6 days having elapsed before the appearance of the first, and 18 before that of the last blades; while the ears did not begin to appear for 37 days more, or the 55th from the date of sowing: this was in March, during which and the succeeding month, in the early part of which the blossom must have been developed, the temperature ranged from 70° to 80°.[†] But according to the table given below, the mean temperature of these months on the S. side of Antigua, is respectively 73° 6. and 76° 7., differing but little from the

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[*] *Meteorological Table, from a Journal kept in St. Peter's Parish, in Lat.* 17 *deg.* 8' *N and Long.* 81 *deg.* 48' *W.—From Nov.* 1, 1836, *to Nov.* 1, 1837.

Month	Barometer		Thermometer			Rain in Inches	
	Max.	Minim.	Max.	Minim.	Mean	Inches	Tenths
Nov.	30.04	29.90	84.0	66.5	76.1	2	57
Dec.	12	94	83.0	61.3	75.5		21
Jan.	10	95	86.2	62.0	75.2		65
Feb.	14	98	85.8	67.0	71.7		5
Mar.	05	89	87.0	64.5	73.6	3	4
Apr.	03	89	84.0	69.8	76.7		48
May	06	92	85.5	73.0	79.7	2	66
June	05	96	86.5	74.0	80 4	3	16
July	04	90	86.0	74.0	86.8	1	93
Aug.	08	37	87.5	75.0	80.9	4	57
Sept.	03	88	85.5	74·4	77.8	4	77
Oct.	04	82	86.5	73.8	79.7	7	24
Mean	30.06	29.86	85.6	69.6	77.8	2	36

[†] We shall presently see, from Mr. Gilbert's table of the mean temperature of the 4 months occupied in his experiment, (and which, with the exception of August, are the hottest of the year,) that this range embraces the mean temperature of that period, which from the table referred to does not appear to have exceeded 77°-7 or 2°-7 more than (75°) the mean of Mr. Butler's extremes. The mean temperature of the Antilles, according to Humboldt, (De. dist. Geog. Plant. p. 78) is 81°-5, of Cumana, 81°-26, and of Vera Cruz and the Havannah, each 78°-08. The following table exhibits, according to the same authority (p. 80,) the mean temperature of the two coldest and two hottest months at the Havannah:—

	Latit.	Coldest Months.		Hottest Months.		Diff. between coldest and hottest.
		Dec.	January	July	August	
Havannah.	23°.8' N	71°.78	70°.16	83°.11	83°.54	13°.38

mean of Mr. Butler's observations, or 75°. Hence, we can hardly attribute any material influence to difference of climate, since a far greater difference, amounting to from 20° to 30°, exists between the mean temperature of the cycle of vegetation of corn in Europe, and in Barbary and Egypt;* which latter regions present not only the higher temperature, but the more abundant harvests: and upon a comparison with the mean temperature of the four months occupied by Mr. Gilbert's experiments, to be given presently, we shall find *an excess of no less than* 5°7 on the side of Barbary and Egypt. If then we were, from analogy, to attribute any effect to the trifling difference shewn to exist between the climate of New Providence and that of Antigua, we must give the benefit of it to the latter. But during the period of the formation of the ears, the fecundation of the ovary, and the swelling of the grain, this difference could hardly have exceeded, 5°, or 7° less than the difference of that of the cycle of the vegetation of corn in Egypt and the months of April, May, June, and July, in Antigua; a difference utterly insufficient to account for the difference in the results.

A cause far more likely to operate to the prejudice of the Antigua harvest, may perhaps be found in the difference of moisture precipitated in the shape of rain, at the most critical stage of the crop, that namely of blossoming. Mr. Butler complains of the drought which prevailed during the three months of his experiment, while during the two months of blossoming in Antigua, no less than 14 inches of rain fell. Now the unavoidable effect of such a degree of humidity must have been either to make the anthers burst and shed their pollen prematurely, or to wash off a considerable portion from the stigmata before it could be conveyed to the ovary, thus producing imperfect fecundation. Had the rain been confined to the first and last stages of growth, it might have been beneficial; in the first place by accelerating the growth of the plants, and in the next by filling the grain. And this shows the importance of selecting the time of sowing, so as to afford the best chance of having dry weather during the period of flowering: a matter of little difficulty within the tropics, where the seasons recur with such unchanging regularity; and where the chief requisite is a knowledge of the mean interval between sowing and blossoming, and the duration of the latter, deduced from the registers of a number of experiments, repeated at various seasons and under various circumstances.

Sir W. Colebrooke does not appear to have succeeded in obtaining details of either Dr. Nugent's or Col. Byam's experiments; the omission, however, has been supplied by memoranda, kindly furnished by the Revd. Mr. Gilbert, an intelligent and enterprising proprietor, to His Excellency, of which the following is a copy:—

"MEMORANDA OF AN EXPERIMENT ON THE GROWTH OF "THE VICTORIA WHEAT.—On the 1st of April, 1838,† a spot of "virgin soil in which a single crop of the Sweet Potatoe‡ had been "raised, was planted with some of the Victoria Wheat sent by Dr "Hamilton to H. E. Sir W. Colebrooke. The soil was of medium "quality; and the seed was planted by the dibble in holes one foot apart, "and at the distance of one foot each in the row. Two grains were

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* See page 18.

† The 6th day of the moon's age.

‡ Batatas edulis.

“ deposited in each hole, and 550 holes (or about the 176th part of an “ acre) were thus planted.* The crop had 2 or 3 occasional weedings, “ and was reaped (owing to its ripening unequally) at successive periods, “ in the end of July.† The weather, during the whole time of the “ experiment, was more than usually favourable, and although the “ ripening of the crop was *somewhat retarded* by the rains which fell in “ July, yet it did not appear to have sustained any injury on that account. “ An abstract of the rain and temperature is subjoined :—

Months	April	May	June	July	Mean
Rain in inches and dec. parts	3.05	8.32	5.68	8.80	6.4625
Mean Temperature	76.7	77.2	78.6	78.3	77.7

“ The height of the plants when ripe was about 2 feet, and the produce, “ with 5 or 6 inches of the straw attached to each ear, weighed 4½lbs. “ The clear grain weighed about 20½ oz. avoirdupoise.‡ In order to institute a comparison between this and English Wheat, a measure of the “ best English Wheat, lately received from Whitehaven, and an equal “ measure of the Victoria Wheat, were weighed, and their relation to “ each other was found to be as 131 to 108 ; consequently, supposing the “ English Wheat to weigh about 60lbs. to the bushel (which is the usual “ weight) a bushel of Victoria Wheat would weigh 49½lbs. : and from “ hence it appears, that an acre of Victoria Wheat would, under similar “ circumstances, amount as nearly as possible to 5½ Winchester bushels. “ The grain is hard and shrivelled, and the only use to which it appears “ applicable, besides the feeding of stock, is the manufacture of Maccaroni and Vermicelli. For the purpose of ascertaining the truth of this “ supposition, equal quantities of flour of the Victoria and English

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* No mention is made of any kind of dressing ; although it must be obvious to any one acquainted with Antigua, that the soil is no where of sufficient fertility to yield a remunerative crop without the aid of manure. Lime is an almost indispensible auxiliary to Wheat tillage (see note at page 37); and if not naturally present should be artificially added. This is economically effected in districts in which lime is scarce, by steeping the grain, for 24 hours before sowing in lime water, and planting the seed thus encrusted with a thin coating of carbonate of lime, which not only serves as a protection against Smut, Pepper Brand, and the depredation of insects, but supplies, in the cheapest and least laborious manner, that which was wanting in the soil. Calcareous marl, as Dr. Nicholson informs us, is chiefly found in the Northern and Eastern division of Antigua, but the prevailing constituent in the other districts presents an argillaceous character.

† This gives a mean interval of little less than 121 days or about 31 more than were required in Jamaica, Barbados, or Mr. Butler's experiments in New Providence: and from 45 to 50 more than the interval required, according to Humboldt, in the fertile vallies of Aragua.

‡ Assuming the weight of the 500 grains sown to have been (at 136 to the drachm) 220.59 ; and that of the return 8968.75 grs. (20½ oz.), the return amounted to 39.077, or 39 for 1. At 2 grains to each hole, with an interval of 1 foot between each, an acre will contain 87,120 grains, weighing, at 136 to the drachm, (or 15,867 to the lb. avoirpupoise,) 5.49191 or nearly 5½ lbs., the return from which, (at 20½ oz. from 500 grains,) should be 3,435,520 grains, weighing 216.52 lbs., and measuring, at 49½ lbs. to the bushel, only 4.374 Winchester bushels, or above 1 bushel below Mr. Gilbert's estimate. This, if incapable of improvement, would, I admit, hold out no great encouragement to cultivate Wheat in the West Indies. But as Mr. Gilbert's experiment was made under very considerable disadvantages, we should not hastily form an opinion from it, which further experience may prove to be incorrect.

"Wheat were subjected to the necessary operation for separating the "gluten,* which was at once perceived to be *extremely abundant in "the former sample;* and, on being weighed, was found to exceed that "of the English Wheat in the proportion of 2.5 to 1. The bran also is "very abundant, and exceeds that of the English Wheat in about the "same proportion as the gluten. Samples of the ears, grain, flour, and "bran of the Victoria Wheat are forwarded with these memoranda, for "inspection and examination. A sample of English Wheat is also enclosed. The only circumstance worthy of notice in this experiment on "the Victoria Wheat, is the unusual proportion of gluten which it "appears to contain. It is, however, in this respect, deceptive. The "bran is equally abundant with the gluten; and the superabundance of "these two constituents merely arises from the imperfection† of the grain, "which, if filled up as it ought to be, with the due proportion of fecula, "would lose this distinctive character, and resemble other specimens of "the Cereal tribe. If, however, such an article should be desirable for "any economical or manufacturing purposes, it certainly may be obtained in small quantities, although at considerable labour and expense.

"Gilberts, 10th Aug., 1838."

It will be seen, on reference to Mr. King's Report at page 28, that its "requiring so little attention" is one of the reasons given by him in favour of Wheat tillage; and, with respect to labour, Mr. King states in the same report, that "the *only attention*" his crop "received, was *once weeding through the drills*": while, by adopting Mr. Young's plan, to be given under the head of Barbados, of planting it in the rows between the young ones, the objection of *expense* is removed.

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* "In the process of obtaining the fecula of Wheat, the flour is made into a paste "with water, and kneaded in the hand, or rather in a coarse linen bag, water being "poured on it till the fecula is carried off and suspended in the water, and the sugar "and other soluble principles in a state of solution. There remains, at the end of this "process, a soft viscous substance, of a fibrous texture, possessing great tenacity and "elasticity. It is this which is denominated gluten. It is obtained in largest quantity from Wheat, the quantity, on an average, amounting to about 1-12th part of the "weight of the flour of that grain; or, taking into account the weight of the water "with which it combines in its extraction, it varies, according to Beccaria, from 1-3d "to 1-5th of the weight of the flour."—Murr. Chem. vol. iv. p. 156.

"From the nature of this principle, it must contribute much to the nutritious quality of the grains in which it exists, as containing *all the principles* which are required "for animal nutrition: hence the superiority of Wheat, which contains it in so large a "proportion to the other nutritive grains. It is on the presence of this principle, too, "that the superior quality of bread from wheat, compared with that from other grains "or roots depends, as Beccaria remarked. The flour of these forms, with "water, a solid friable paste; while the flour of wheat forms a paste that is ductile and "elastic, in consequence of the development of its glutinous part, this gluten forming "the body of the paste through which the farina and saccharine matter are diffused; "and when the slight fermentation which it suffers, probably from changes in the saccharine matter, favoured by the presence of the gluten, takes place, this paste is "rendered spongy and porous, from the disengagement of the carbonic acid gas from "the fermentive process, while it still retains its elasticity; and hence the lightness and "porosity of well-baked wheaten bread. Bread possessing these qualities, cannot be "prepared from the farina of oats, barley, rye, or rice, or from that of any of the nutritive roots, as in all these the quantity of gluten is very inconsiderable, and in some of "them no trace of it can be discovered."—Ibid, page 163.

† The imperfection here spoken of, was not, improbably, much increased by the quantity of rain which fell during the critical season of blossoming.

In a note to his Excellency which accompanied these memoranda, Mr. Gilbert says, "he would with pleasure undertake farther experiments on "this subject, but having repeatedly made them in former years, both on "specimens of Wheat from England, and also on others obtained *from* '*the banks of the Apure;* and having extended these experiments to "Oats,* Beans, Rice, and similar plants, he feels *perfectly convinced* "that all such attempts in this part must prove abortive."

It cannot be sufficiently regretted, that a gentleman so eminently qualified for the task, as the report just given abundantly proves Mr. Gilbert to be, should have arrived at such a desponding conclusion, upon such inconclusive grounds. If, as he informs His Excellency, in the passage last quoted, the Wheat which was the subject of some of his previous experiments, was really the produce of the plains of Casanare, watered by the Apure and the Meta, and not that of the table land of Bogotà, some other cause than that of the heat of the climate, or want of elevation above the sea, must be sought for. The elevation of San Fernando de Apure, (seated near the confluence of the Apure, the Arauca, the Cabullare, and the Guarico,) is stated by Humboldt† not to exceed 217.413 English feet above the sea; while its distance from the coast of Caraccas, in the most direct line, is not more than 50 leagues, or 150 geographic miles; and the whole of the vast and level tract bordering on the Apure, and extending from the mountain wall which forms the Western boundary of the great plains of Casanare to their Eastern limit on the left bank of the Orinoco, and from the right bank of the Apure to the left of the Meta, occupying nearly 2° of lat. and 5° of long., can hardly at any point exceed, if it does not fall short of that elevation.‡ Hence, *in this respect,* no part of this extensive district can possess any advantage over Antigua; while its temperature, for the greater portion of the year, rises considerably higher—San Fernando being, as Humboldt observes, "celebrated for the excessive heat "that prevails there the greater part of the year." "We went," says this distinguished traveller, "provided with thermometers, to the flat "shores that border the River Apure, which are covered with white sand. "At 2 in the afternoon I found the sand, wherever it was exposed to "the sun, at 52° 5 (126° 5 F.) The instrument, raised 18 inches above "the sand, marked 42°.8 (109°04 F.); and at 6 feet high, 38°7

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* See, as a reply to this, Mr. King's statement, at page 28.

† "According to the height of the mercury in the barometer, the waters of the "Apure have only a fall of 34 toises from San Fernando to the sea."—Pers. Narrative, iv. p. 306. The distance of San Fernando from the sea, *by the course of the Orinoco,* is stated by him to be about 160 leagues; but across the Llanos, or Plains of Calobozo, the direct line to the Carribean Sea does not exceed 50. "It will scarcely be believed," says Humboldt, "that the Villa de Fernando de Apure, only 50 leagues distant in a "direct line from that part of the Coast of Caracas, the longest inhabited, was founded "only in 1789."—Ibid, page 391.

‡ "Considering the surface of the globe as a polyedron formed of plains variously "inclined, we may conceive, by the mere inspection of the maps, that the intersection "of these slopes, rising towards the North, the West, and the South, between San Fer-"nando de Apure, Caycara, and the mouth of the Meta, must cause a considerable "depression. The savanahs in this basin are covered with 12 or 14 feet of water; and "present, at the period of the rains, the aspect of a great lake, the farms placed on a "sort of shoals, scarcely rise 2 or 3 feet above the surface of the water."—Pers. Narr. iv. page 393.

"(101. 66F.) The temperature of the air under the shade of a Ceiba[*] was "36.°2" (97° 26 F.) At sunrise on March 28th, during a thunder storm, he found the temperature to be 74.66 F.; falling, towards the conclusion, to 71°. 6. from the "evaporation from the surface, and freer radia- "tion towards the sky." When he left San Fernando, at 4, P.M., on the 30th of March, the temperature, notwithstanding a strong breeze from S.E., was 98° 2 F. in the shade. At sunrise on the 1st of April, the temperature of the air, in a sinuosity of the Apure called *La Vuelta del Joval,* a little below the mouth of the *Cano de la Tigrera,* which connects the Apure and Apurito, forming the Eastern shore of *Isla Blanca,* was as low as 75° 2 F; its usual range during the day being from 86° to 95°.; the water, however, continued from 78°8 to 80°6F. The air, on the following morning, was at 82°40F.; while "the dry and white "sand of the beach", notwithstanding its radiation towards a sky without a cloud, retained a temperature of 96°.80 F. Hence the mean temperature of April on the banks of the Apure, deduced from this data, appears to be from 86° to 87 F. at least, or above 10° beyond that of the same period, as given by Mr. Gilbert, at page 42, or the table at page 40. If, therefore, as Mr. Gilbert's note seems to imply, Wheat admits of successful culture in these hot, low, moist situations, within 7° of the line, some other cause than either *want of elevation, proximity to the line, or excessive heat,* must be sought to account for its failure in Antigua.

We have already seen Wheat flourishing *nearly at the level of the sea,* in New Providence, lat 25°.[†]; in Cuba, lat. 23°[‡]; in Haiti, lat. 18°.[§]; and in Jamaica, lat. 17.° 52′[‖]; and we shall presently see it flourishing equally in Dominica, lat. 15°, only 33 feet above the sea; in Barbados, lat. 13°, at a lower level; and in St. Vincent, lat. 13°. 15′. at the level of the sea: examples which corroborate, still more strongly, the fact of this culture being equally independent of diminution, of latitude, and of elevation; and point to the existence of other laws for its regulation, the successful investigation of which will completely bring it under human controul.

Mr. Gilbert regards the preponderance of gluten, in the Victoria over the English Wheat, as the result of a defect in the grain, arising from a deficiency in the farinaceous constituent. According to Vogel, 100 parts of European flour contain 68 of starch or fecula, 24 of gluten, 5 of gummy sugar, and 1.5 of vegetable albumen, leaving 1.5 unaccounted for. The flour of Mr. Gilbert's wheat contains 60 per cent. of gluten, or 3-5, leaving only 40 per cent, or 2-5 for the remaining constituents. The flour of the Antigua Victoria Wheat, therefore, may be presumed to consist of 34 starch, 60 gluten, 3.5 gummy sugar, and 1 vegetable albumen, with 1.5 loss in 100 parts. Sir H. Davy assigns to the flour of Wheat sown in Autumn 77 per cent of starch, or 37 more than Mr. Gilbert's, and 19 of gluten, leaving only 2.5 per cent. for the rest; while Spring Wheat contains 70 of starch, and 24 of gluten, leaving 4.5 per cent for the other constituents. As we advance South, the proportion of gluten increases; and, from this cause, the flour of the United States (where the mean temperature of the cycle of vegetation of corn, considerably exceeds that of the same period in Great Britain,) is, as the bakers well know, more profitable than British, incorporating with a larger proportion of water, from its containing more gluten. Hence, the excess of gluten, regarded by Mr. Gilbert as a defect, appears to be the result of an improved climate, and, *within proper limits*, to be an advantage in place of the reverse: it appears probable, also, from what has been already stated, that had Mr. Gilbert's grain been fuller and heavier, the increase of weight would have been found to arise not so much from an increased proportion of starch, as from a corresponding increase of all the other constituents; leaving to the gluten nearly the same relative preponderance as he observed. The defective weight and size of the grain may partly have been occasioned by the lateness of the season of sowing, and the consequent sluggishness of growth, which procrastinated its flowering to June and July, when much of the pollen may have been washed away before absorption by the stigmata; or the anthers may have burst before the ovaries were ready for their contents. The want of dressing, also, and the deficiency of lime in the soil, may, in some degree, account for the poverty of the grain, without imputing more to the influence of climate than is just. "The Carribean Islands," as Dr. Nicholson informs us,* "are, in a geological point of view, divisible "into two distinct classes; the one occupying the mountainous range on "the western side, exhibiting all the characters of recent volcanic "action; the other, composed of the low islands forming the Eastern "chain, presenting in a more or less regular order, the calcareous strata "of the upper marine formation, dipping towards the East. The first "embraces all the islands on the Western side, from St. Vincent to "Saba; in the other are comprised Barbados, Deseada, Grandeterre in "Guadaloupe, the Northern half of Antigua, Barbuda, St. Bart.'s, "St. Martin's, Anguilla, and Anegada. Santa Croix exhibits, also, a "stratified formation of the same character, but with an inclination in "the opposite direction; it would appear, therefore, to lie on the Western "side of the line of volcanic action. Antigua occupies an intermediate "position between these two classes and partakes more or less of the "characters of each, consequently, it presents an interesting study to "the geologist. It comprises three distinct formations of the *tertiary* "class, of which the most superficial beds occupy the *northern* and "*eastern* division of the island. These consist of a *calcareous marl*, and "*coarse sandstone*, interspersed with masses of tolerably compact *shell* "*limestone*. The *mountainous* district, forming the *Southern* and "*Western* divisions, is composed of rocks of the newest *floetz trap* "*formation*, as *wacke*, *prophyry*, *trap breccia*, *amygdaloid*, and some "spherical masses of *basaltic greenstone*. The *intermediate* district, "is occupied by a series of *argillaceous strata* of various characters. "The *most superficial* consists of a *loose friable marl* of a yellow colour, "with olive brown spots containing numerous concretions of a lenticular "form. The *next stratum* in the series is of a more compact and

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[*] Bombax Ceiba, Silk Cotton Tree. The maximum temperature in Antigua, in March, 1836, was 87°, and the mean did not exceed 73°, while the mean of July and August, the two hottest months, does not appear to have exceeded 83°.85. See note at p. 40.

[†] See pages 31 and 36. [‡] P. 18 and 24. [‖] P. 6. [§] P. 26.

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* Antigua Almanack for 1836. p. 42.

" homogenous texture, being a *white indurated clay*, of a slaty structure
" intersected by seams which divide it into tabular masses. *Inferior*
" to this, we find another tabular rock of a coarser grain than the last,
" which being highly impregnated with *green earth*, presents a beautiful
" sea green or bluish colour. The *next*, and *lowest* in the series of this
" formation, is a stratum of a liver brown colour, and conglomerate
" character, having imbedded in it masses of different species of *the*
" *trap family*. All these strata dip at a considerable angle to the N.
" and N.E., and extend across the island from the ridge to the neigh-
" bourhood of St. John's. The order of stratification is somewhat
" disturbed by the *irruption* of a large mass of the *trap family* at Drew's
" Hill.[*] This spot is worthy of a more minute examination, for it con-
" tains the *only* marks of *recent volcanic action* that have, as yet been
" discovered in this island. *Streams of Lava*, some more compact,
" others vesicular, are found at the base of the hill, bearing the impres-
" sion of the leaves of dicotyledonous plants, among which may be
" recognized those of the *Ficus pertusa*, and a species of *Melastoma*.
" These three formations do not pass interceptibly into each other, but
" are divided by well marked natural boundaries. The *southern* limit of
" the *Calcareous* district is formed by a zone of low land, extending
" from Willoughby Bay on the S.E. to Dickerson's Bay on the N.W.
" which, at no very distant period, appears to have been submerged by
" a narrow firth, dividing the island in two, like the *Riviere Salée*, of
" Guadaloupe. The *Claystone* is divided from the *trap formation*, by
" the *Body Ponds*, and the stream which issues from them, running
" towards the N.W. through a beautifully luxuriant plain. The surface
" of each district presents also peculiar features. The *Calcareous* is
" exceedingly broken and undulated, consisting of a series of round
" backed hills of no great elevation, covered wtth a light and arid soil.
" The summits of these hills are covered with the wild sage (*Lantana*
" *involucrata*), among which the *Loblolly* (*Pisonia subcordata*), *Croton*
" *balsamiferum*, *Rauwolfia nitida*, and other shrubs are interspersed.
" The sides of the hills and intervening vallies are highly cultivated,

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[*] This reminds us strongly of the Basaltic Rock of Roche Rouge, a league and a half from Brives, in Velay, spoken of by Faujas de St. Fond, in his elaborate work, entitled
" Recherches sur les Volcans éteints du Vivarais et du Velay," p. 364, where he says
" Les matieres volcaniques sur lesquelles on se trouve en partant de *Brives*, commencent
" á disparaitre vers les environs d'un pont qui sert pour la route du *Monastier*: on
" entre alors dans des granits à grand bancs irréguliers, de couleur rougeâtre sur la
" superficie, ce qui probablement a fait appeller ce quartier *Roche Rouge*, nom qui se
" rapporte plutôt à ces rochers de granit, qu'à notre butte basaltique. On ne tarde
" pas à apercevoir, et à reconnaitre de loin le rocher pyramidal dont il est question ; il
" n'est abolument environné de toutes parts que de granit ; nulle *coulée le lave* nul
" *cratere*, nul *volcan* apparent dans le voisinage qui ait pu le produire : tout est
" absolument granit, à plus d'un quart de lieue, et même demilieue à la ronde."....
" Il est difficile de distinguer les points de contact, et l'on ne peut se former aucune
" idée positive encore de la maniere dont cette masse s'est établie. Mais quelle fut ma
" surprise, et mon etonnement, lorsqu'en faisant le tour du rocher, je reconnus, dans la
" partie opposée a celle qui fait face au chemin, que la nature avoit ici levé un coin de
" son voile, si je puis m'exprimer ainsi ; en effet on reconnôit d'une maniere claire,
" positive, et indubitable, que cè rocher de Basalte est sorti par l'effort d'une explosion
" volcanique de l'interieur de la terre, s'est fait jour à travers l'epaisseur des granits, et
" s'est soutenu sur lui même, en s'elevant majestueusment hors de terre, jusqu'à la
" hauteur de plus de 100 pieds sur un diametre d'environ 60."

" and produce a rapid growth when duly favoured with rain. The *Clay-* " *stone formation* presents a precipitous escarpment towards the S. and " S.W. and a gentle declivity in the opposite direction. This is *the* " *most barren district* in the island, considering that it is every where " accessible to the implements of husbandry. The district occupied by " the *trap formation* consists of mountains, some of which rise with " *conical* summits to the height of 800 or 1,000 feet, others of the same " elevation are more rounded, and less preciptous, affording a good soil " for the sugar cane, even on their tops. They are intersected by " beautifully romantic vallies, and the abrupt sides of the mountains are " clothed with the verdant foliage of a great variety of herbs and trees " and twining shrubs."

From this interesting and graphic sketch we learn, that with the exception of the district to the North of a line drawn from Willoughby's to Dickerson's Bay, the soil of Antigua is chiefly argillaceous, and hence, ill-suited to the growth of wheat without the addition of lime: an addition which appears to have been omitted in Mr. Gilbert's experiment, and may, perhaps, account for the degeneracy of the crop. Of Mr. Gilbert's grain I am unable to speak from personal observation, having been deprived through the Post Office of a bundle sent to me by Sir W. Colebrooke packed in coarse brown paper, but which through the mistake of a waterman at Falmouth, was put into the Post Office and reached me with a charge of £1 13s. for 12oz. of brown paper, straw, chaff, and wheat, worth at the most 1s.; which *moderate* and *reasonable* demand for a parcel which came so unfairly into their possession, the Post Office authorities refused to reduce to less than 4s. or *above* four times its outside value. Fortunately, however, the disappointment was in some degree compensated by the safe arrival of a sample of the Wheat raised by Dr. Nugent, which His Excellency had also the kindness to send.

Taking at random three ears out of this bundle, I found the two fullest to contain 39 and 30 grains each, and the poorest 24, giving a mean of 31. The 39 weighing 12 troy grains, the 30 and 24 weighed each 9½ grains, giving a total weight of 31 grains for the whole 93, and averaging .3333333 of a grain for each corn; at which rate 139.724, or nearly 139¾ grains, would be required to weigh a troy drachm, and 20,569.2 to counterpoise a pound of 7000 troy grains.* The average of a conside-

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* The following table exhibits, as Col. Le Couteur requested, (page 35) the number of grains which weigh a scruple, of the undermentioned sorts. Those with French names were sent to me by the kindness of M. Vilmorin, of Paris. I have omitted the Col.'s samples, as their weights are for the most part given in his own pamphlet :—

1. Petanelle blanche	18
2. Talavera	18
3. Aubaine rouge	23
4. Blé d'Odessa	24
5. Blé du Cap	25
6. Blé barbu de Naples......	26
7. *English Victoria*	28.5724
8. Blé trimenia barbu de Sicilie	30
9. Blé du Crete..............	33
10. Blé de Mars rouge barbu	34
11. Blé de Mars blanc sans barbe ordinaire	35
12. Blé herisson	37
13. *Bahama Victoria*	38
14. *Barbados Victoria*	40
15. *Dominica Victoria*......	44
16. Blé de Mars carré de Sicilie	44
17. *Caracas Victoria*	45.3333
18. *Antigua Victoria*	46.5757

Where fractional parts occur, the result has been obtained by computation from the number that counterpoised a drachm or 60 troy grains.

rable number of trials of the original Caracas seed, gave .44176 of a grain for each corn, 136 grains for a drachm, and 15,867 for an avoirdupoise pound: exhibiting a superiority of weight of each corn of .10784 of a grain over the Antigua sample; clearly marking a degeneracy attributable neither to climate, temperature, or elevation. We have already seen that 114* grains of the New Providence Wheat, raised within 4 feet of the level of the sea, weighed 1 drachm, giving a mean weight of .5263, or above ½ a grain for each corn, being an increase, as compared with the original seed, of .08513 of a grain; and an excess of .19297, or nearly two-tenths of a grain above the Antigua produce. This difference cannot be accounted for otherwise than from a difference of soil, of season, or of dressing.

The latest intelligence I have received of the Wheat tillage in Antigua, is contained in the following paragraph taken from the *Globe* of the 20th of July, 1840, which states, that "in Antigua they had succeeded in "rearing silk-worms, and the culture will probably be extended to other "islands. The Victoria Wheat had also come to perfection, although it "required 115 days to ripen." In the absence of more minute details, it is difficult if not impossible to assign a satisfactory cause for this anomaly, which certainly cannot result from the influence of climate, but may be occasioned by some peculiarity in the composition of the soil. Mr. Young, of Barbados, acquaints me, in a letter of the 27th of July, 1840, that he has seen "by the public prints that they have at length "succeeded on a large scale in Antigua."—The details of these experiments will, I trust, reach me in time for a second edition.

§ 2. *Dominica.*

Ever anxious to promote the public good, Sir W. Colebrooke availed himself of the zeal and philanthropy of Mr. Joseph Phillips, a stipendiary magistrate of Dominica, to extend the benefit of Wheat culture to that island also; and it was, I believe, through this channel that a portion of seed reached the Rev. G. Clarke, Rector of Roseau, who, in a letter to His Excellency,† acquaints him that he planted 15 grains on the 17th of Nov. 1838, on the East and as many on the West side of a small garden, enclosed by a stone wall, and elevated about 30 feet above the sea. Of those planted on the West side, a few grains sprouted and came up on the 3rd day; but, from some unexplained cause, drooped and perished after a sickly growth of a few days. This may have resulted from something unsuitable in the soil, from the absence of manure, or the attack of insects, none of which causes are beyond the reach of cure. Of those planted at the same time on the East side, *the whole* came up on the 3rd day, producing 11 tillers each, or 165 plants, averaging 22 seeds each, and yielding 3,630 grains, or 242 for 1. The crop ripened a few days (?) after the 1st of March, 1839, or in about 104 days from the time of sowing. The grain, as Mr. Clarke observes, was *fuller* and *of a better quality than the original seed:* a result similar to that obtained in Jamaica and New Providence. In these latter, however, dressing was employed to improve the soil; while Mr. Clarke is silent on this point, and we are left without any means of determining to what cause this improvement is to be ascribed, or what occasioned the failure of that sown on the West side of the garden; but it is possible that the success in the one case may have resulted from some accidental admixture of lime in the soil, and the failure in the other from its absence. Two of the ears which His Excellency had the kindness to send me, weighed 30 grains: and the corn they contained weighed at the rate of 132 grains to the troy drachm, or 15,400 to the avoirdupoise pound, being an improvement of nearly 467 grains in the pound upon the original seed, fully justifying the opinion expressed by Mr. Clarke. The length of the straw somewhat exceeded 2 feet. The weather was of the description most favourable to the success of the experiment: having been showery for some time after sowing, but fine and fair during the time of blossoming, and while the grain was ripening. The sowing took place on the day of the full moon, and the harvest occurred about the same time in the March following. The time of sowing does not seem to have influenced the germination of the seed, since the blade appeared above ground on the 3rd day; yet, notwithstanding this rapid germination, it took about 14 days longer to attain to maturity, than that sown between December and April, a period which appears to be more congenial to the habits of the plant, and corresponds more nearly with the season selected for sowing in Venezuela. It is possible, however, that this retardation may have resulted from the slower ascent of the sap during the last 14 days of the moon which followed the sowing.

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* See note, p. 33.

† Dated "Roseau, 12th March, 1839."—In this letter, Mr. Clarke acquaints Sir W. Colebrooke, that "Mr. Phillips was at the Rectory this morning, and saw some "Victoria Wheat in ear. He said it was the *first* that was raised in Dominica, and he "was sure, as your Excellency had sent the seed to this island, you would be pleased to "see its success. The experiment was tried on a very small scale. I procured only 50 "grains from a friend."

A second experiment, attempted by Mr. Clarke, in the same garden at a more favourable season, unhappily failed, as in the first experiment on the west side of the garden. Here 20 grains were sown on the East side on the 7th of February, 1839, being the 22nd day of the moon's age. The plants appeared on the 5th day, and soon after died away without any assignable cause. This failure taking place on the very same side of the garden, on which the 15 grains, sown in November, were at that very time coming to maturity, seems to show either that the soil and the situation, in the former case of failure, were guiltless of the result, or that the former success arose from some accidental cause, meriting enquiry, and admitting of imitation; the effect of which would be to render success uniform and certain. From the occurrence of germination, and the subsequent decay of the plants after attaining a certain stage of their growth, it seems probable that the failure arose from the attack of insects beneath the surface, which destroyed the grain before the young plants had become independent of the nutriment it contained. The admixture of quicklime or vegetable ashes with the soil, some weeks before sowing the grain, would have destroyed these insects, and thus preserved the plants: or the admixture of soot or some similar substance have had the effect of keeping them at a distance until the plants were beyond the risk of injury. Mr. Bauer found that wheat, steeped in lime water for 12 hours, and then dried well in the air before sowing, was secured against the attacks of the *Pepper Brand (Uredo fœtida)*, one of those parasitic fungi which fasten upon plants *of the most vigorous growth*, and is frequently found adhering to the grain, before sowing, but which is destroyed by the lime, which not only kills the adhering fungi, but renders the grain unfit for supporting others. This process would not only have the effect proposed, but also guard the seed from the depredations of insects, and supply, in an economical manner, an essential ingredient to the soil.

Mr. Clarke, in the concluding paragraph of his letter, informs His Excellency, that he has given a written report of his experiment to Mr. Phillips,—a gentleman whom he represents as taking a deep interest in the subject; but says, he did not imagine Mr. P. could make any use of it till he had collected a greater number of facts. He gives it, however, as the conclusion at which he had himself arrived, that "all we can infer "at present is, that *Wheat will grow and ripen in Dominica, and "produce grain of a good quality*, though of a small size. Should it "be found," he continues, "that it can be raised here upon a large "scale, and that the grain improves in fulness, the introduction of it "must be a source of great advantage." In Mr. Clarke's successful experiment, this improvement had, as we have seen, already commenced; the size and weight of the produce exceeding the parent grain in the proportion of 132 to 136, or as 1 to 1.03: the Dominica Wheat, averaging .454555 of a grain, or nearly half a grain each corn; while the parent seed did not average more than .44176 of a grain, or .13369 of a grain less. An improved system of culture with the selection of the largest grains for seed would have the effect of notonly further improving the quantity of the grrin, but diminishing the risk of failure.

§ 3. *Saint Christopher.*

To bring the cultivation of Wheat more directly under the notice of the landed proprietors in this and other islands under his government, Sir W. Colebrooke procured the insertion of a series of articles on the subject in the Saint Christopher Advertiser of the 26th February, and 12th and 19th of March, 1839. Notwithstanding which, and the liberal offers of His Excellency to furnish seed and advice to such as would apply, the great majority of the planters continued blind to their own interests, neither profiting by the information contained in the papers, nor manifesting the slightest wish to avail themselves of His Excellency's generous offers. Rum, Sugar, and Melasses continued to dance before their imaginations in all the dazzling splendour of those by gone days in which the atrocities of Slavery and the Slave Trade rendered human life of little value, and the rich fertility of their teeming soil combined with the absence of foreign competition, to render Sugar cultivation a mine of wealth. Each succeeding year, however, must impress upon them the salutary, though, perhaps, unpalatable truth, that those are days gone never to return; that the abolition of Slavery, no less than the Slave Trade, has taken from them for ever the power of tasking human bones and muscles beyond the limits of their physical strength; and that, if they would save themselves from that ruin, which has been temporarily averted by the prodigal grant of Britain for the freedom of their slaves, the means must be sought in the introduction of other objects of industry than those which have hitherto formed the great staples of West Indian commerce. Among these, few can be found more valuable, either as a source of domestic supply, or of foreign trade, than Wheat.

The population of Great Britain and Ireland, which was 20,874,158 in 1821, had increased in 1831 to 24,044,917, being an increase of 3,170,759, or 317,075.9 per annum; at which rate of increase, the population at the next decennial census, in 1841, may be expected to reach to at least 27,215,676, and in 1851 to no less than 30,386,435, (9,512,277 beyond the number in 1821), or nearly one-third increase in 30 years. But while our domestic population advances with such gigantic strides, the territory which has to provide it with sustenance, not only is incapable of expansion, to meet the growing wants of its augmenting population, but is actually in the process of diminution from erosion by the surrounding ocean. If, therefore, the population, while yet under 27 millions, be out of proportion to the productive capabilities of the space to which it is confined, how fearfully will that disproportion annually increase, and how much will its dependance upon external supplies be augmented. Hence, in promoting the culture of wheat in our own colonies, while we are adding to the resources of the inhabitants, we are at the same time virtually extending the space for feeding our home population, and enlarging the market for the products of its industry. These are truths which cannot be too strongly impressed upon the inhabitants both of Great Britain and her colonies, and which, if duly weighed, will disarm our home agriculturists of any irrational jealousy which they may entertain respecting the progress of wheat culture in our West Indian settlements.

I availed myself, in the early part of 1837, of the appointment of my friend, Lieut. Chambers, to the Barrack Department at St. Kitts, to send a supply of Victoria Wheat to that island for trial, but with what result I have never yet been able to learn. My first report of experiments on the culture of wheat in that quarter, was furnished by Mr. R. Olpherts, a stipendiary magistrate, who found leisure, in the intervals of his official duties, to prosecute useful and benevolent pursuits. This is the gentleman to whom society is so much indebted for the introduction of the farinaceous produce of a species of *Canna** said to be the *Canna*

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* This plant, of which some roots were kindly sent to me by Mr. Olpherts, and are now growing at Pontey's, appears to differ so much from the *Canna coccinea* of our collections, that I am inclined to suspect it will prove a distinct and possibly nondescript species, identical, perhaps, with the *Achira* of the Chocò: a few months will, enable us to determine this point. Mr. Olpherts, in his letter, gives the following history and description of it, which certainly appears to indicate a very different species from that to which Dr. Sadler referred it:—" I must acquaint you that I *first* " introduced this *farina (Tous les Mois)* to the notice of the British public. When " I arrived here, in 1834, the plant was cultivated in the gardens of a few negroes " resident on a property belonging to the Earl of Romney; and, having been told that " the farina made from it was much superior to the Arrow Root, I purchased some, " and found it as reported. I procured a few plants, and, having prepared a sample " with care, presented it to Dr. Waterson (since dead), at that time the cleverest man " of his profession in the island, for his opinion and report, which having obtained, I

coccinea, into use as a substitute for that of the *Maranta arundinacea*, or Indian Arrow Root, to which it is in many important respects superior, as I can attest from experience in my own family. This gentleman, in a letter dated "Carrick Brae, St. Kitts, 31st May, 1839," acquaints me, that "His Excellency Sir William M. G. " Colebrooke, permitted me to take samples of every description of " Wheat in his possession ; but I am sorry to say that but 3 grains out " of the whole vegetated ; and these were the English White Wheat ; " the ears of these are small, but the grain promises to be bold and about " 40 in number." "I am much attached to agricultural pursuits, and " pass my leisure hours in my garden, and on my farm (10 acres) ; the " latter purchased to enable me to carry on my hobby unmolested. It " forms part of an abandoned estate called 'Dry Hill', is situated at an " elevation of 1200 feet above the level of the sea on the South West " side of the island, one mile due East of Brimstone Hill, and is there" fore (as I think) well calculated for experimental cultivation. Such is the site and elevation of the spot selected by Mr. Olpherts for the theatre of his experiments; and certainly a more judicious one could hardly have been chosen for the trial of European seed. To this cause it may be ascribed that the White Wheat, which refused to form ears in the Governor's garden at Nassau, completely succeeded here, although but three grains retained their vitality: yielding, as a subsequent letter of the 12th of June informs us, four ears, averaging 40 grains each, which were cut on the 94th day from sowing, the weather during the period having been dry. I since furnished Mr. Olpherts, by the Magnet packet, in October last (1839), with an abundant supply of Victoria and other Wheats, accompanied by Barley and Oats, which have, I trust, reached him in good condition, and will enable him to prosecute his experiments upon a more extended scale.

" sent it home to Drs. Ryan and James Johnson, with specimens of the farina for trial " and report. A reference to Dr. Ryan's Medical and Surgical Journal, dated August, " 1836, and to Dr. Johnson's Medico-Chirurgical Review, dated October 1st, 1836, " will furnish you with the opinions of these three gentlemen upon its properties. " The botanical name, *Canna coccinea*, was given to the plant by Dr. Sadler, the only " person then in the island at all conversant with Botany. I think the term indefinite ; " and shall be glad of your opinion on the point. As a food for infants whose mothers " are deficient in 'Nature's proper aliment', and to the dyspeptic, it is invaluable. " It never ferments on weak stomachs, and is highly nutritious. I spent a good deal " of money in my endeavours to make it a marketable commodity. I have encouraged " the cultivation of it among the negro population, and have given plants to all who " applied for them ; and in the Parish in which I reside, there is scarcely a peasant's " garden unadorned with this beautiful plant. I have sent plants to Bermuda, by the " Rev. Thomas Jefferies, Wesleyan Missionary. If you have not seen this plant, you " will be delighted with the beauty of its appearance. Its usual height is about 4 feet ; " but, with attentive culture, I have had them 16 feet high, and the size of the bulb " increased in proportion. The return, in suitable soils, is immense. It loves a rich " loam, with a Southern or Western aspect, and when it has taken root, it almost " defies weather. The flower is of a rich vermillion hue."

I regret being obliged to add, that a report has reached me, which I trust may prove unfounded, of the death of this amiable and philanthropic individual ; leaving a widow and five infant orphans to deplore his loss, and society to lament being deprived of the exertions of so valuable a member in the very midst of a career of such disinterested utility.

Sect. IV. *Windward Islands.*

§ 1. *Barbados.*

In November, 1835, I availed myself of the opportunity presented by Lieut. Potbury's going to Barbados to assume the command of the Flamer, Government Steamer, to convey by that gentleman a supply of Victoria Wheat to H. E. Sir L. Smith, then Governor of that island, accompanied by a letter explaining my views, and the grounds of my expectations; but of this supply no use appears to have been made: at least no report has ever reached me, although it must have arrived at the very best season for trial, about the beginning of January, 1836. Hence, it happened, that in place of profiting by this supply, Barbados had to wait about three years before the experiment could be tried there, as it was most successfully, by Mr. B. T. Young, in 1839, with seed furnished through the untiring zeal of Sir W. Colebrook.

It has been mentioned, when speaking of Dominica,* that His Excellency had found in that island, an able and zealous coadjutor, in Mr. Phillips, a Stipendiary Magistrate, by whom a portion of Victoria Wheat, (accompanied by some papers on the subject, which he had received from the Governor,) was given to Commander Joseph Hamilton, R.N. Armed with this supply and information, Capt. Hamilton returned to Barbados, where he deposited both the documents and the Wheat, for distribution among such as chose to try it, in the hands of a merchant of the name of Orderson, resident at Bridgetown; by whom, in furtherance of Capt. Hamilton's benevolent wishes, the former were inserted in the "Barbadian", of the 12th of January, 1839, and the latter divided between Mr. Young, and 10 or 12 other gentlemen, none of whom, with the honourable exception of Mr. Young, appear to have profited by the gift.† In the following May, Mr. Young transmitted an account of his success to the " Barbadian", in which his letter was published on the 15th of May, with the following introductory remarks which clearly evince the interest beginning to be taken in the subject:—

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* Page 49.

† These particulars are extracted from the following letter from Captain Hamilton, published in The Barbadian, for the 29th of May:—

"Sir,—The success which has attended Mr. Young's laudable effort in the cultivation of the Victoria Wheat, has been particularly gratifying to me, as the medium through which it was *first (a)* introduced into this island. It is now about six months since I received a small sample of this wheat from Mr. Joseph Phillips, of Dominica, who has been zealously anxious to promote its cultivation through all the islands, having, by experience, ascertained its rapid vegetation and amazing fecundity. With the grain, that gentleman also forwarded to me the documents which appeared in your valuable Journal, on the 12th of January last, to which I beg to refer your agricultural readers for some interesting particulars respecting the Wheat. Those documents, together with the chief part of the seed, I placed in Mr. Orderson's hands, who kindly undertook to distribute it amongst the planters, and procure your publication of the documents; and, as I am well assured, at the same time that he put a portion of the grain into Mr. Young's hands, he divided the remainder between 10 or 12 other gentlemen. It is, however, to be regretted that *none of them, except Mr. Young,* then (as it, appears) *gave any attention to its cultivation,*—but its value being now well tested by that gentleman, who with a zealous purpose of promoting the interest of his country,

(*a*) Without wishing to detract from my gallant namesake's merit, I must beg leave to refer to the text above for proof that this arose from the inhabitants of Barbados not having had the good fortune or happiness to meet in their Governor, the zeal, urbanity, and philanthropy, of Sir W. Colebrooke.

" With exceeding pleasure we publish Mr. B. T. Young's valuable communication on the cultivation of the Victoria Wheat. The public will, in time to come, owe much to the patriotic zeal of this gentleman, and to the practical application of his talents and knowledge, to the benefit of his country. We received from a friend of Mr. Young's, yesterday, a sample of the Wheat produced on his estate, at the moment that an experienced agriculturist was with us, who pronounced the grains to be as full as any he ever saw in England. He received an ear of the Wheat also, and means to cultivate this valuable plant. We have no doubt it will be generally cultivated; and will, at no very distant period, form a staple article of West Indian produce. When we shall be insensible to the things of earth, and shall be where there will be neither sowing nor reaping, other generations will perhaps recollect that a newspaper called the Barbadian first brought to the notice of the planters of Barbados, the cultivation in this island of this Victoria Wheat, when they are eating their delicious bread made from it."

" Fairfield, 13th May, 1839.

" Mr. Editor,—Feeling a sincere and intense interest in all that relates to the improvement of agriculture in our islands, as well as the promotion of practical science beneficial to society, I have great pleasure in sending you an account of my first trial of the Victoria Wheat upon this estate, which has been attended with the highest success, and indeed with success exceeding my most sanguine expectations. I had a small parcel of grains given me by a friend in the early part of January, and as they appeared quite fresh, and newly reaped, I embraced the earliest opportunity of rain to sow them, which was on the 15th of January,* the spot chosen was the highest and lightest part of a field trenched throughout, in which canes had been planted the previous month in the trenches. I mention these circumstances particularly rather as drawbacks to a full and fair trial, unincumbered with any other plant: yet, nevertheless, I was not disappointed in the result. The mode I adopted in the planting was

" has placed the produce of his experiment in Mr. Orderson's hands for distribution " I conceive there is a fair chance of its being generally cultivated, and therefore take the liberty of requesting those gentlemen who sow it, to furnish me with the following dates as to the progress and circumstances of its cultivation, for the purpose of transmitting the same to Mr. Phillips, of Dominica, for his and Sir Wm. Colebrooke's information, His Excellency having taken a lively interest in the cultivation of this wheat.

" 1st.—Date sown. 5th.—No. of grains sown.
" 2d.—Date ears shoot. 6th.—No. of ears produced.
" 3d.—Date reaped. 7th.—Average number of grains in each ear.
" 4th.—General state of weather. 8th.—In what kind of soil and manure sown.

" I remain, Sir, your obedient servant,
" JOSEPH HAMILTON, Commander, R.N.

" Camperdown, Two Mile Hill, 24th May, 1839."

" P. S.—Mr. Orderson informs me, that he has, to this date, distributed 250 ears among 54 applicants."

* This was the day of New Moon.

" *to dibble in the seed* upon the top of the bank, *an inch deep**, 2 grains " in each dibble, firmly pressed in the ground about 12 inches apart. "I do not think, upon a close inspection, a single grain failed to grow; " and I should have obtained, I am now certain, *a greater return for the " quantity I planted, had I dropped only one grain in each dibble*;† for " *I never beheld any plant sucker more abundantly*. At the end of " 90 *days* it was reaped‡. Although the major part of that time, we " *had but little rain*, with sultry suns and calms, discouraging to vegetation in general, *the Wheat appeared to be but little affected*, thus " proving the hardihood of the plant. *Not an atom of manure was " bestowed upon it*, yet the ears were for the most part full shocks, containing in many instances from 50 to 60 grains each. This experience " exemplifies the fallacy of the idea generally prevailing, that Cerealia " will not succeed in low situations, corresponding to the level of the sea, " within the tropics. The lands of Fairfield estate are about 2½ miles " in a geographic (direct?) line from the sea, and for the most part in a " loamy and clay soil, with a superstratum of black mould, and *nearly " coincide in point of level with the sea*; and surely, if the Wheat has " succeeded so well there, the success may be expected to be greater in " the higher lands of the island. It is true that Victoria, from whence " the name of the Wheat is derived, is situated about 2,000 feet above " the level of the sea, and consequently in a milder region than this and " the other West India Islands (saving the higher lands of Jamaica): " yet, if I apprehend rightly, its cultivation has been extended to the " lower lands of South America; and, through the laudable zeal of Sir " Robert Ker Porter, has been introduced and propagated in some of " the islands, the results of which have not transpired, at least I have " not seen them. That the culture of this Wheat is *advantageously " practicable in the West India Islands*, may now be considered as " *satisfactorily tested and proved*; and it can be no slight inducement " to the planter, in turning his attention to its propagation, to learn, " that it will yield, *with moderate attention*, upwards of 3,000lbs. to " the acre each planting, and that the same land, exclusively devoted to " its propagation, will give 4 crops within the year. I would therefore

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* The depth should vary with the nature of the season and the soil, being deeper in light porous soils and dry seasons, for reasons which will be explained hereafter. From 3 to 4 inches is the depth recommended by Colonel Le Couteur; but in tropical countries a greater depth might often prove advantageous. Mr. Benjamin King, a farmer of Eastbourne, planted for experiment 11 grains of Wheat in holes 3 inches deep, every one of which came up and produced as many plants, which tillered so profusely that some had 94, and others 107 ears, averaging 30 grains each, or 3210 for 1; with straw, in some instances, 5½ feet high. These were the admiration of the neighbourhood on the 30th of August, 1839; and were visited, among others, by the chairman of the Harlstone Farmer's Club, in Norfolk, who observed, that " they speak volumes " in favour of depositing the grain beyond the reach of most birds or insects; by which " means, too, it is little liable to be injured by the frost," or, in tropical countries, by heat or drought: " and the roots spread sufficiently before it rises into stalk, to supply " sap for making stiff straw, and well filled ears."

† Col. Le Couteur advocates planting thick, in order that the accumulated heat of germination may quicken vegetation: but this is unnecessary within the tropics, is attended with a needless expenditure of seed, and counteracts the increase by tillering.

‡ On the 15th of April, the 1st day of the Moon's age.

"seek to draw the attention of the Planters of Barbados, to the "cultivation of so valuable a plant.* I have, with this view, deposited "at the store of Mr. Orderson, the gentleman from whom I obtained the "seed, some of the produce, grown at Fairfield, in its native ear, this "gentleman having kindly offered to distribute portions of it, as far as "it will go, to all who feel an interest in the cause of agriculture and "humanity. When its *productiveness* is taken into consideration, and "*the short interval* required for its growth and maturation, it will be "found as valuable a plant to propagate as even the staple of Sugar, "and *with half, nay a fourth of the manual labour* required for Canes.† "It is now evident, from causes not necessary to be detailed or entered "upon here, in an article of this kind, but which are too palpable and "obvious to the most superficial observer of human events, *that the* "*staple of Sugar is likely to retrogade*, and it behoves the planters thus "early to look abroad for *other* sources of cultivation *requiring the least* "*manual labour*; and with this view, I should rejoice to see not only "this plant propagated generally, as an article of export, but the "Mulberry tree introduced into Barbados, and the cultivation of "Silk.‡ With regard to this Wheat I should say, that this season of the

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* It is to be hoped that this advice, given by one of their own body, will not be thrown away upon the planters. Assuming Mr. Young's anticipations to be realized, the return per acre will be sufficient to gratify the most insatiable cupidity: 3000lbs. ought to measure about 50 Winchester bushels at the rate of 60lbs. to the bushel, or 59.2265 at Mr. Gilbert's estimate of 49½lbs. The seed required for an acre, planted singly in holes 12 inches apart, amounts to 43,560; weighing, at 45 grains to the scruple, (or 136 to the drachm), 2.754lbs. Hence Mr. Young's return was about 1092.74 for 1. But in ground sufficiently manured, and favourable for tillering, the return should have been at least 2,395,800 ears, yielding 155,727,000 grains, weighing, at 13,000 grains to the pound, 11,708.8lbs., and measuring 287.054 bushels, or 35.881 quarters, worth, at 40s. per quarter, £71. 15s. 3½d. for the gross produce of a single acre. Were it practicable, it would be injudicious in the extreme, and contrary to the most approved principles of modern husbandry, to take 4 successive crops of wheat from the same spot of ground; the rotatory system of cultivation being the only one which can be advantageously pursued. Taking 90 days for the average duration of each crop on the ground, but 5 days of the whole year would remain for preparing the ground and putting in the seed; being little more than 1 day for each crop, which would be utterly insufficient for the purpose. With all deference to Mr. Young's more practical experience, I should fear May would prove an unfavourable season for sowing, all our *present* experience indicating the best time to be between Christmas and Lady-day.

† Mr. Young might also have added "*Risk and Expense.*"

‡ Besides these I should also suggest, the *Madia sativa*, an annual long cultivated in Chili for the sake of its oil, which is highly valuable for machinery, as it only thickens slightly at 42° 75 Farenheit. It is a plant with an erect annual hairy glandular viscid stem; oblong, entire, semi-stem-clasping leaves, those on the upper part of the stem being alternate, those below opposite; and yellow flowers in racemose heads. It forms the type of the *Madieæ*, (a division of the *Senecionideæ*), and is distinguished by its roundish 1-rowed involucre with carinated bractes enveloping the grains, the receptacle plane, paleaceous at the margin and naked in the middle, with 4 or 5 bald achenia tapering to the base. It has been tried with success in Germany, where a German acre yields 442lbs. of oil; while the same space cultivated with Poppies yields only 264lbs, and with Rape 240lbs. October is said to be the best month for sowing, a German acre requiring from 4 to 6lbs. of seed. The crop requires little care beyond threshing out the seeds soon after it has been cut, to prevent the effects of the fermentation of the stalks. The Olive (Olea Europea) originally from Asia, and flourishing only in warm countries, also merits attention.

"year is the most proper for a trial. I am, Mr. Editor, your obedient
"servant, B. T. Young."

This report establishes the fact, that wheat may be raised with advantage nearly at the level of the sea, and in a season distinguished for a smaller quantity of rain than usual, as far South as the 13th parallel of latitude; and that the "*causæ locis propriæ, nec satis erutæ,*" applied by Humboldt to the cultivation of this grain in the vallies of Aragua, and Quatro Villas, are to be sought for in the groundless and irrational prejudices fostered by the system of Slavery, and not in any real incompatibility either of soil or of climate; and justifies us in concluding, that it would be equally successful in Tobago,* Trinidad,† Essequibo,‡ Demerara,§ Surinam,‖ or even under the line itself, provided due attention be paid to the nature of the soil, choice of the season, and application of manure.

Of the spot which was the theatre of this experiment, Mr. Young has furnished the following particulars, in a letter of the 19th of December, 1839. "The lands of Fairfield Estate, as I stated in my "first paper, are for the major part a loamy and clay soil, with a "superstratum of black mould, with little calcareous matter—it is "highly genial to the Cane plant, which thrives most successfully, and "stands in high repute for its superabundant returns of sugar; the "manure for which has been chiefly that derived from cattle, and some"times soot as a dressing. With such a soil, the impression with me is, "that the lighter the manure the better it will answer for Wheat. The "higher lands of the island present a light calcareous soil, and doubtless "would suit the culture of wheat better than what I possess: but I fear, "*from prejudices of long standing, it will take time to work itself into* "*favour:* indeed I saw a small patch there under beautiful growth from "seed I supplied, the growth of Fairfield. The West India Islands, for "the greater part, are unhappily subject to severe droughts, *this among* "*the others,* which, at times, mar the best efforts of industry. Such has "been the case with this island during the present year. The months "of July, August and September witnessed a scourge of this kind; so "that Wheat I planted in the month of June,¶ proved a failure: and to "this cause I attribute the loss of the greater part of the seed I distributed "to numerous applicants from my first planting. Above 150 planters "and others, who had become interested by the novelty of the culture, "upon seeing my paper of the 15th of May, participated in my first "production, so that, in the extent of my liberality to encourage the "culture of this 'Staff of Life,' I left myself entirely bare, relying

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* Mean Lat. 11° 12′. † Mean Lat. 10° 26′. ‡ Lat. 7° 0′. § Mean Lat. 6° 34′.
‖ Mean Lat. 5° 52′.

¶ When Wheat is planted during seasons in which drought may be expected, it will be advisable to bury the seed deep—say from 6 to 9 inches below the surface—especially in light sandy soils: this may occasion a delay of a few days in the appearance of the blade above ground, but the delay will be more than compensated by the future vigour and rapid growth of the crop; making the entire interval, between sowing and ripening, little, if at all, greater than it would have been, were the grain planted nearer the face. The seminal roots, being thus placed beyond the ordinary influences of drought, ply moisture and food to the plant, at a time when the coronal roots are unable either from the parched and thirsty surface of the soil. See note on this page 56, and also the next chapter § 3, towards the end.

"upon a return from that planted in June; in which, as I before told "you, I was disappointed by the drought. The supply I have so seasonably received from the worthy Governor of Antigua has, being "plentiful, set me upon my feet again. As the originator in this island "(the most ancient, and proverbially the most loyal of H.M. Colonies) "of the culture of Victoria Wheat, I entertain an anxious desire to see it "established as one of the staple products of our beautiful little isle, as "much on the score of humanity, as from the coincidence of name with "that of our amiable young Queen; and any suggestion you can offer for its "successful culture, will at all times prove acceptable."

One of the most valuable facts furnished by these reports, in a practical point of view, is the method adopted by Mr. Young of planting the Wheat in the intervals between the canes, by which both space, labour, and manure are greatly economized; while the necessary hoeing of the corn must prove beneficial to the canes. Another is, the good effect of planting the seed at wide intervals, by which not only an enormous saving of seed is effected, but greater space left for the plants to tiller. The richer the soil, and the more highly manured, the greater may be the intervals between the plants; while to enable them more effectually to resist the evils of drought, the holes should be not less than from 4 to 6 inches deep; by which means the seminal roots will be removed farther from the influence of aridity, and enabled to spread more widely in quest of food and moisture. Mr. Young's experiments likewise point out the importance of selecting the time of sowing, so as to afford the crop the best chance of rain in the early stages of its growth, and fair weather during the period of flowering. Two of the ears transmitted by Mr. Young to Sir W. Colebrooke weighed together 70 grains, and 2 sent by Capt. Hamilton, 69 grains, in all 139 grains, giving the average of 34.75 grains for each. Of the two first ears, 1 contained 49 grains, weighing 24½ troy grains, being at the rate of 40 to the scruple, 120 to the drachm, and 14,000 to the avoirdupoise pound. From the appearance of the ears I expected to find the grains heavier. The weight of a single corn of Antigua Wheat averaged .43878 of a grain; of the original Caracas seed .44176; Barbados .5; and New Providence .526.

While these pages were passing through the press, a letter reached me from His Excellency Sir W. M. G. Colebrooke, from Dominica, of the date of the 4th of May, 1840, accompanied by, what he justly terms, "a most interesting communication, just received from Mr. "Young, of Barbados, with a sample of the crop of Victoria Wheat, "which he has raised under the *most unfavourable* circumstances. "This success in Barbados is most important. The island is populous, "and every additional resource is valuable. Here, and in the other "Leeward Islands, the planters are prejudiced, apprehending the "diverting of labour from Sugar cultivation. However, the object will "be progressively accomplished." Mr. Young's letter, which is of the date of the 30th of the preceding April, is little more than a transcript of that published in the Barbadian, of the 11th of April*, and inserted

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* "BRIDGETOWN, SATURDAY, APRIL 11, 1840.
"It is now satisfactorily proved by Mr. T. Young, that the soil of this island is well "adapted to the cultivation of that most valuable article of food, *Victoria* Wheat.

in the note; to which he adds—“ It is now very gratifying for me to have
“ it in my power to inform your Excellency, that the planters of
“ Barbados are becoming daily more sensibly alive to the advantages
“ of Wheat cultivation, and more especially of this particular species.

“ That this plant will take that high place in our agricultural productions to which it
“ is justly entitled, must depend upon the spirit and enterprise of such men as Mr.
“ Young; who, *not obstinately wedded to old systems*, but directing their thoughts to
“ the grand object of making their native country as much as possible independent of
“ other countries for supplies of food (a duty of the very first importance in the present
“ critical state of our political relations with the United States of America), will readily
“ embrace the opportunity now offered them of serving their country in a most material
“ point—we mean the obtaining of *the greatest quantity of food at the least outlay of*
“ *money*, and *with the least manual labour*. Mr. Young has established the fact of
“ this wheat giving *an unexampled return* to the planter,—*one single grain having*
“ *produced four thousand!* Which of our esculent plants has ever given such a return?
“ Our great staple of old times,—a most valuable plant to be sure,—the Guinea Corn,
“ has never, we understand, so amply rewarded the labours of the planter. And can our
“ agriculturists overlook the advantage which Wheat possesses over Guinea Corn, in
“ the fact, *that three crops at any rate*, if not four, in the year, may be obtained, while
“ Guinea Corn never gives more than one crop? *The times seem to us*,—we make the
“ remark with great deference to the better judgment of our planters,—*to require more*
“ *than ordinary attention to the raising of food*. We know not the moment when our
“ intercourse with foreign states may be seriously interrupted. Ought we not to
“ provide, as far as human ability and energy can, against the possible, nay the probable
“ evil, of our accustomed supplies being cut off?

“ If the cultivation of Victoria Wheat be followed up with spirit and energy, the
“ country will, in a few years, produce the material for bread of the purest and most
“ wholesome kind. When the cultivation of wheat shall be general throughout the
“ island, then will some enterprising individual come forward with his machinery for
“ *grinding* that Wheat. At this very time, we are informed, that a gentleman in
“ Jamaica, who has invested a large sum in machinery, is making his fortune rapidly
“ by grinding the Wheat imported in the grain, by which means people in Jamaica are
“ enjoying the comfort of eating bread, which they know to be of the purest quality,
“ free from adulteration of ground *bones*, and other substances which, it is notorious,
“ are used in the manufacture of bread in England, and perhaps in America.

“ We drop the subject for the present, referring our readers to the subjoined corres-
“ pondence between Mr. Young and the Chairman of the Commercial Hall, and
“ recommending all friends of the island to go there and look at the beautiful sample of
“ Wheat produced at Mr. Young's Estate.”

“ Fairfield, April 1st, 1840.

“ My dear Sir,—As Chairman of the Commercial Hall, I take leave respectfully to
“ present to you, and the Mercantile Body, a specimen of Victoria Wheat, the produc-
“ tion of this Estate, and perhaps you will be so good as to have it exhibited in the
“ Hall, for the gratification of its numerous subscribers.

“ The Bunch is not as large as one taken up a few days since, nevertheless I believe
“ you will find the Ears of this as full and as large as they usually are in England—
“ the one alluded to is now in the possession of His Excellency the Governor, and
“ reckoned, when it was taken up, *eighty-one stalks*, and some of the ears contained
“ about *sixty grains*—this you will readily join me in saying is a return almost
“ unprecedented from a single grain of wheat—the fruitful land of Canaan (a land
“ described in Holy Writ as flowing with milk and honey) at the time of our Saviour,
“ in the parable of the sower, mentions at the utmost only one hundred fold, whereas
“ the bunch in question would number somewhat about *forty-eight hundred fold*.

“ It was planted on the 29th December, by irrigating the land, owing to the drought
“ then existing, and with the exception of rains in February, has had to contend with
“ much hard weather, thereby evidencing not only the hardihood of the plant, but its
“ prolific properties even under such disadvantageous circumstances, and exemplifying
“ its adaptation to general culture in the tropics.

“ I have the honour to be, my dear Sir, your obedient servant,

“ B. T. YOUNG.

“ Henry George Windsor, Esq., Chairman of the Commercial Hall.”

"The other species which your Excellency was so good as to send "me, has not been attended with the same success. I beg to refer your "Excellency to the 'Barbadian' newspaper, of the 11th instant, a copy "of which I send you,—and have, &c. &c. B. T. Young."

The sample accompanying this letter, which I have placed at the disposal of Captain Trotter, R.N., for trial on the Coast of Africa, was of fair quality, but much below the standard which I trust it is destined to attain, under the matured experience and improved agriculture of this enlightened and meritorious cultivator. Having been planted on the 29th of December, and reaped about the 26th of March, (or a few days before the 1st of April) it occupied the short interval of 88 or 89 days in coming to maturity. Fifty nine of the best grains counterpoised half a drachm troy, whence it would appear that 14,087 grains would weigh 1lb. avoirdupoise; while the original Caracas seed gave 15,867, or 1.780 more to the same weight.

§ 2. *St. Vincent.*

In a letter of the 10th of July, 1839, Sir R. K. Porter informed me, that the success of the Wheat in other islands had directed the attention of the inhabitants forcibly to the subject, in consequence of which, as he acquainted me, "I had an application from the Governor of St. Vincent's for some, and have been obliged to send to Victoria for a supply "for His Excellency, which will, I trust, be forthcoming by the next "mail boat returning to Barbados, so that it may go to him next month. "I really am rejoiced to find, that this valuable acquisition has become "so well and so usefully known." This intelligence was highly grati-

"REPLY.

"Commercial Hall, April 7th, 1840.

"My Dear Sir,—Various causes have occasioned a procrastinated meeting of the "Committee of this Hall, since I had the honour to receive your very interesting letter "of the 1st instant, until the present time.

"The Committee have received your most beautiful and flourishing bunch of Victoria "Wheat in luxuriant growth, as a specimen of agricultural production, the most novel "and possibly the most important ever produced in this Island: important, they "conceive, not only for its vast prolific return and rapid growth to maturity,—but for "the magnitude also of the discovery of so great an internal resource in an Island so "densely populated, and that may at any time be curtailed in its external supplies by "the operations of war.

"The Committee request that I would assure you, on behalf of themselves and the "subscribers to the Hall, that they accept with great gratification your valued present "of the bunch of Victoria Wheat, which they appreciate the more as being of your "own culture; and they solicit to add the expression of a hope, that your example of "enterprize and industry in thus eliciting the resources of your native soil, for the "humane and patriotic object of securing to its labouring population the greatest "necessary of life, which might, under other circumstances, be unattainable by them "will induce other eminent Agriculturists within the Tropics, to engage in corresponding researches for the benefit of their fellow creatures.

"It affords me great pleasure to have the opportunity of thus addressing you in "behalf of the Commercial Hall; and the more so, as I am permitted to add the assurance of my own personal esteem and my admiration of your great and energetic "exertions in the best interests of this Island.

"I have the honour to be, Sir, your most obedient servant,

"H. G. WINDSOR,

"Chairman Commercial Hall."

fying, as marking the progressive decay of that absurd and fatal prejudice which has so long deprived the West Indies of the fruits of this most precious gift to man. Apprehensive, however, that, as had been the case with Mr. Burnley, some difficulty might occur, at that advanced period of the year, in obtaining the desired supply, I addressed a letter to His Excellency the Governor, on the 28th of August, 1839, covering a few grains of Barley, Oats, and Wheat for trial, and referring him to Sir William Colebrooke for a more ample supply, should Sir R. K. Porter be unable to answer his requisition. A subsequent letter from Sir Robert, of the 26th November, 1839, acquainted me that he had succeeded in obtaining the desired supply, and inclosed a note of acknowledgment from his Excellency Sir G. Tyler, dated "Government "House, St. Vincent, 7th November," in which his Excellency says, "to prove the probability of its succeeding in this Colony, I inclose an "ear, 1 of 12 that were produced from 2 grains planted in the latter end "of June, and reaped the 10th Oct." This, which Sir Robert kindly inclosed, was as fine an ear as any I have seen from the W. Indies. Along with it he sent me the St. Vincent Gazette, of the 16th Nov., in which the Editor informs us that "we have the pleasure to state that we have "in our possession a very fine ear of wheat, raised in this island from "seed received from Barbados, in June last. It was planted on the "heights of Buccamont, in the latter part of that month, and came to "perfection in October. Other seed, planted in the mountains near "town on the 24th of July, was ripe by the 1st of November,* but not "being immediately gathered, a large portion of the grain was destroyed "by the birds. These instances of its successful cultivation, it may be "said, prove only that it can be brought to perfection in the high lands; "but, in reply to this, we have further to state that we have now as fine "an ear of Victoria Wheat as any of those above described, which is "growing in an inclosure before our office in town, *only a few yards* "*from the sea*, planted at a later period, and we look for a further "increase from the same plants in the course of a few days. These "specimens we shall be happy to show to any person who may desire "to see them, and shall be gratified to receive such further particulars "respecting the cultivation of the seed lately distributed to upwards of "40 applicants, as our friends may be pleased to communicate." In addition to this testimony of the public press of the island, Mr. Young, in the letter already quoted† states, that "The planters of the island "of St. Vincent appear to have entered with zeal into the matter; in "the month of June, I had many applications for seed from thence, "which I readily supplied; and the result I copy from the 'Barbados "Globe' of the 5th instant (Dec.) 'We are glad to see by our St. "'Vincent papers that the cultivation of Victoria Wheat in that island "'is prospering. A supply of seed obtained from this island in June "'last, was planted on the heights of Buccamont in the latter part of "'that month, where it came to perfection in October; and seed "'planted in the mountains near town on the 24th July, came to "'maturity on the 1st November.'" Although this is but a repetition of the information already given from the St. Vincent Gazette, it is important, as marking the degree of interest which the inhabitants of Barbados take in the question—an interest which it is to be hoped will spread rapidly to the other islands, and contribute powerfully to the eventual success of this great agricultural improvement.*

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* On the 100th day.

† Page 58.

§ 3. *Grenada.*

From Grenada I have not yet received any reports, but learn from a letter from Sir W. Colebrooke of the 28th of October, 1839, that it was then "about to be introduced, which as it will be the Depot of "the Steamers, will have great facilities with the other colonies "of the West Indies. My friend the Lieut. Gov., Col. C. J. Doyle, will "promote the object, and if you should write to him you can allude to "my suggestion." I accordingly wrote to Col. Doyle on the 30th of December, 1839, and inclosed a few grains of Victoria Wheat, which went by the Sheldrake Packet; but I have not yet heard in reply.

Sect. V.—*Curaçao.*

Besides the English Islands noticed in the preceding pages, Sir R. K. Porter, with that generous philanthropy which views man, in whatever region he may be placed, as a member of the same great family with himself, has extended his considerate care to the neighbouring island of Curaçao, although lying beneath the protecting shade of a Dutch, in place of a British flag. Few places could be more unfavourable to the experiment, in every point of view, than this island, which is naturally the most arid, barren, and unproductive of the American islands, being dependant for every drop of water required for the wants of man or those of the soil, upon the rain of heaven, which is carefully preserved in tanks for use in the dry season. It is under these discouraging circumstances, which will enhance the value of the boon in the event of success, that Sir Robert, with a zeal which surpasses praise, has furnished a supply to the Governor, who, in a letter of the most grateful and flattering thanks, informs him that, if the wheat does succeed, he "*will in truth have given bread to the inhabitants;*" and promising to let him know how it succeeds. If the season of sowing shall have been selected with judgment, and the soil sufficiently improved by dressing, I feel little apprehension as to the result, and shall hail with pleasure the arrival of intelligence.

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* In the absence of fuller information respecting the Meteorology of St. Vincent, the following Register for one week, taken from the St. Vincent Gazette for the 16th of November, 1839, may be interesting:—

1839.	Thermometer.		Barometer		Hygrometer		Rain in Inches	
Nov.	Morn.	After.	Morn.	After.	Morn.	After.	Inches	Dec. Parts.
9	80	85	30.19	30.22	50	50	..	09
10	79	83	19	21	51	50	1	22
11	78	82	19	23	52	53	..	75
12	79	85	18	25	53	51	..	93
13	79	84	12	23	52	51	..	20
14	78	85	11	—	52	—	..	30
15	79	83	16	22	52	51	1	19
Mean	78.857	83.3857	30.163	30.225	51.7	51.	..	66857

CHAP. III.

ADVANTAGES AND SUGGESTIONS AS TO THE MANAGEMENT OF WHEAT TILLAGE.

§ 1. *Advantages of Wheat Tillage.*

To those who, like myself, have witnessed the suffering produced in our islands by an interruption of the customary supplies of corn and flour from the United States, through the occurrence of hostilities, or failure of the harvests, it may be superfluous to enlarge upon the advantage of securing even a partial supply of these first necessaries of life from domestic sources, without being dependent, as at present, upon distant lands and far less favoured climates.

But, independent of this, there are other advantages hardly second in importance, which call for a brief notice in the present place.

The happy change which has been recently effected in the constitution of society in our West Indian possessions, calls for the introduction of other objects beside the cane and the coffee plant, to extend the operations of industry, and afford the labouring part of the community that power of selection which their peculiar circumstances may require. The culture of the cane being far more laborious than any other, requires the exercise of greater physical strength, and ought, in proportion, to be more liberally remunerated than any other. Hence those labourers whose muscular powers are equal to the task, will find upon the sugar plantations a richer remuneration than the less valuable harvests of wheat could afford, or the lighter labours of such tillage entitle them to receive. Thus this addition to the productive industry of our colonies cannot fail to benefit a large proportion of the working classes as well as their employers.

But the ingenious experiments of Mr. Young, of Barbados,[*] have shewn, that the cultivation of the cane and of wheat can be carried on together in the same field, not only without interfering with each other, but with manifest advantage to both; producing a vast saving of ground, of labour, and manure—advantages too obvious to be farther insisted upon.

While the costly outlay of capital, the length of time consumed in its growth, and the great fluctuations in the amount of its return, necessarily restrict the culture of the cane to the wealthier class of proprietors; the infinitely smaller capital required for wheat tillage, the lighter amount of labour to be expended upon it, the diminished risk of loss, and the greater promptitude of return, place it as fully within the reach of the ten acre cultivator in Barbados, as of the wealthiest planter in Jamaica: nay, even the poor and hitherto despised and persecuted black, in the intervals of his daily toil, may be able to till his half or quarter acre of wheat, take the produce to a neighbouring mill, feed his little family with wheaten bread, the produce of his own labour, and thus add, at the cheapest possible rate, to the amount of their little comforts.

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[*] Page 55.

It is not, however, merely as a source of internal supply, but as an object of profitable export, that the cultivation of Wheat promises to be advantageous to the inhabitants of the West Indies. The success of the Victoria Wheat in Canada has been already noticed;* and in a letter from Toronto, of the 15th of October, 1839, the writer observes, that "I really think the Victoria Wheat would prove valuable here. *There "is nothing the farmers are so much in need of as a good description of "Spring Wheat; for that sown in Autumn is continually failing.*" Now it is well known to every practical farmer, that seed raised successively for a long period in the same ground, or even in the same district, rapidly degenerates, even with the greatest care; and that occasional renewals of seed from distant quarters are indispensible. Thus by degrees a new trade may be expected to spring up, and the traders from Canada take the seed wheat of the West Indies in exchange for the staves and shingles of their own forests.

It may be imagined by some, that Rice, which requires a warm climate for its production, would be preferable to Wheat; having been pronounced by Adam Smith, one of the most prolific of grains, and yielding a larger proportion of food than the most fertile corn-field; two crops, of from 4 to 8 quarters, being annually obtainable, per acre, from the same land. Buchannan, however, acquaints us, that although the labour and cost of these *two* crops is *double*, the produce hardly exceeds that of *a single good crop*, raised during the rainy season, and in marshy situations. Hence the *fallacy* of the *double* crops is obvious. From the trials made with Wheat, in Jamaica and New Providence, we may anticipate obtaining in the short space of 90 days, by a due selection of season and soil, and an improved method of culture, a return of at least 32 quarters per acre, or about four times the amount of Adam Smith's *double* crop of Rice. Wheat besides, from the large proportion of gluten which it contains, is far more nutritious than Rice, which consists almost wholly of starch, containing no less than 96 per cent. of it. The culture of Rice, besides, in our West Indian islands, cannot be profitably carried on except in low swampy situations pregnant with *Malaria*, and unfriendly to the constitution of man: while the experiments recorded in the preceding pages abundantly prove, that Wheat can be profitably raised at almost *all levels*, and even in the poorest soils; from the level of the sea, to altitudes of 4000 or more feet above it. His Excellency Sir W. M. G. Colebrooke, in a letter from Antigua of the 22d of April, 1840, acquaints me, that "Mr. Shepperd, a spirited planter of Antigua, "who has successfully cultivated the Mulberry, and produced some fine "silk," "*finds the wheat succeed perfectly;* and he is situated to lee"ward, and by no means favourably, *from the poverty of the soil* and "want of rain." In recommending Wheat, however, to the attention of agriculturists in the West Indies, I must not be understood as wishing to exclude Rice or any other object of profitable cultivation adapted to the climate or the soil. While the Mangrove swamps in the vicinity of the sea, are converted by the culture of Rice from the abode of pestilence, into regions of fertility and wealth, the golden crops of wheat may wave in joyous profusion on the upland heights, and thus jointly contribute their respective proportions to the welfare of the community. "Rice," as His Excellency observes in the letter just quoted, "is cultivated at "Mauritius, and from experience I know that the *purest* atmosphere is "found in 'Rice Swamps,' (as the Americans call them,) in the Paddy "Fields of India." Vegetables, as the beautiful experiments of the illustrious Priestly first taught us, are wisely ordained, by a beneficent Providence, to counteract the tendency of animal life to vitiate the atmosphere, by absorbing the *impure*, and giving out, in an improved state, the *purer portion*; while the continued process of cultivation has a tendency to reclaim the swamp from its watery and pestilential condition, to one of more solidity and health: and even on this account alone the cultivation of Rice *in appropriate situations*, merits every encouragement.

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* Page 21.

In many of our islands that quality of the soil which adapted it more peculiarly to the growth of the cane, has been exhausted by length of cultivation; and in more of our islands the seasons, from causes which it is not my province to investigate, have lost their former character. Mr. Olpherts, in a recent letter,* observes, that "I consider our seasons "here as marked by *great uncertainty*. Old time planters say that in "their younger days they could depend upon periodical rains. I have "been here nearly 6 years but cannot define the wet and dry seasons."

This growing change of climate, to whatever cause it may be traced, operates far more prejudicially upon the cane, than corn tillage; and tends, more than anything else, to recommend the latter to favourable consideration; while those exhausted estates which are no longer capable of yielding a remunerating crop of sugar, may, by careful cultivation, still give profitable returns of wheat; and their mills, no longer required for expressing the juice of the cane, be converted, at a trifling expense, into mills for the production of flour. Thus the introduction of Wheat may have the effect of bringing back into profitable culture estates which have been long abandoned, as in Antigua and St. Kitts; and rendering them once more subservient to the prosperity of individuals, and the welfare of society.

Already, as His Excellency Sir W. Colebrooke informs me,† a "most "important change has taken place in the habits of the negro population, "who have taken to the use of Wheaten bread; and *as we depend "altogether on American flour*, it will be a great object to encourage "the growth of wheat in the elevated parts of the island, especially where "the aspect is northerly. Rice might also be grown in the swamps, "which would ameliorate the climate; and it would be desirable to try "this in all the islands." Here is another inducement to perseverance in endeavours to establish the culture of wheat; while proof has been already furnished of ELEVATION *not being essential* to its success.

[*] 1st Jan., 1840. [†] 4th Feb., 1840.

§ 2 *Of the Preparation of the Ground, Manure, &c.*

From the rocky nature of the soil, as in Dominica, Montserrat, and Nevis, the use of the plough is impracticable in many situations, and the hoe must continue, as heretofore, to be the principal implement of agriculture. Where, however, more approved auxiliaries of husbandry can be employed, a preference should undoubtedly be given to them. In those situations in which the practice of planting Wheat on the ridges between the canes, as pursued by Mr. Young, of Barbados*, admits of adoption, the labour and manure employed on the one, will serve, in a great degree, for both, and thus produce no inconsiderable saving.

Every thing within the tropics teems with life; and the voracity of insects, with the rank luxuriance of weeds, are amongst the more formidable difficulties with which the West Indian agriculturist has to contend: both of these it must be the unremitting object of his care to destroy. Among the means best suited to this end, is the application of *quicklime*, or the *ashes* of marine or terrestial vegetables, *recently* burned, and spread in sufficient quantity on the soil, *about two months before sowing.* "LIME," as Colonel Le Couteur judiciously observes, is so well understood as a manure for wheat, "that it would be a mere "waste of time to say more upon the subject than that, as far as my "own experience goes, it appears to impart a greater degree of whiteness "to the straw than any other manure. Its other good qualities of "*absorbing moisture from the atmosphere in dry weather*, on light or "gravelly soils, are well understood. It is to be lamented that some "*general rule* for its application is not made known; as, in the best "books I have consulted on the subject, it varies in the extraordinary "proportion of from 56 to 500 bushels per acre: which last appears to "me to be an absurd quantity. I have found it to answer perfectly at "the rate of 40 or 50 bushels an acre on a good loam; and I should "apprehend that *double that quantity* ought to be sufficient for the "poorest ground, unless it be to destroy moss; when a still larger top "dressing is required, which, if well harrowed in, does it effectually. "This commixture of turf and lime, if soon after ploughed in, becomes "itself in turn a manure for the very soil that the turf had previously "rendered barren."†

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* See page 55.

"† On the Varieties, Properties, and Classification of Wheat, by John Le Couteur, "Esq., Capt. H.P. late 104th Regiment, Colonel of the 1st Regiment Royal Jersey "Militia, &c. Jersey—Ph. Payn, Royal Saloon: London—Shearsmith, 1836." Of this work it is sufficient to say, that the Agricultural Society of Paris had it translated for the use of its Members, and honoured the author with a medal; while other French Societies have testified their approbation by enrolling him a corresponding Member. Nor has its merit been overlooked at home, since we learn from the Anti-Corn-Law Circular, of the 17th September, 1839, that "At a late meeting of the "English Agricultural Society, Colonel Le Couteur received a prize of £20 for his "Essay on the cultivation of Wheat. This gentleman, who is one of the first "Agriculturists of the day, has for five years been instituting experiments in order to "ascertain the expense and profit of growing the several varieties of this staple of our "Agriculture. From his statement we learn, that the *Hoary White* or *Velveteen* "Wheat, produced per acre, 48 bushels of Corn, worth at 8s. £19 4s., and straw worth "£5 8s. 9d.—total £24 12s. 9d. The expenses of cultivation are £9 6s., leaving a "net profit of £15 6s. 9d. per acre. Of the next variety, the *Jersey Dantzic*

Peat, or the *turf* here spoken of by the Colonel, is a substance of vegetable origin found wherever the soil has been long soaked by water, which has no outlet, and does not wholly evaporate. It consists of roots and fibres in every state of decomposition, and contains a large proportion of tannin, which prevents the decomposition of animal and vegetable substances. In its composition are found all the *elements* of the richest manure, but these require decomposition to convert them into *humus* or *vegetable mould*. This decomposition is effected by lime or alkalies. When quicklime is added to humid peat, the lime is slaked by the moisture, and, combining with the gallic acid, neutralizes it: the addition of animal matter, as dung or urine, excites fermentation, by which oxygen is absorbed, and carbonic acid evolved, converting the residue into a valuable manure rich in soluble humus.*

Lord Western, an agriculturist of well known experience, in a letter to Lord Rayleigh, of the 4th of Sept. 1839, says, "If you ask me what is " high farming, in two words I say ANIMAL MANURE: *Lime*, *Chalk*, " *Marl*, *Saltpetre*, &c. may be administered with advantage no doubt, " but it is *Animal Manure* which alone gives stamina to the land." " From an admixture of *chalk*, *lime*, and *marl*, with *animal manure*, the " best results will follow. Marl prevails all over my estate, I mix it in " large quantities in every compost I make; a layer of dung and a layer " of marl alternately, and turn it over sufficiently often to make it rotten, " and to cut out in a substance. The means of collecting animal manure " are various: my mode is by *sheep feeding*, and particularly by folding " in yards† all the winter through, and indeed spring. The sheep tread " in the straw as well, if not better than bullocks, and their manure is, " I think, better; and mixed with marl, as above described, constitutes " the *best possible means* of producing large ears, and rendering them " *full* and *heavy*. To provide for the Sheep I spare no expense. I make " every effort to produce vegetable crops of every description, and give " corn and cake rather profusely: *well-bred animals* will pay for high " feeding in themselves, *and most decidedly so in the Corn harvest*.

" the items are, produce £23 0s. 6d., expenses, £9 6s., profit per acre, £12 14s. 6d. " The third variety, the *Whittington*, affords £22 11s. 6d. of gross produce, from " which £10.0s. 6d. being deducted for expenses, leave a net profit of £12 11s. The " last sort recorded in the remarks of the gallant Colonel, is the valuable variety called " *Talavera Bellevue*, which produces 52 bushels per acre, and 5,480lbs. of straw, of " which the total value is £26 1s. 6d., while the expenses being only £10.0s. 6d., there " remains the enormous profit of £16 1s. per acre."

* An experiment was tried in 1835, by some farmers in the vicinity of Montrose, on the use of *crushed shells*, as a dressing for turnips, with the greatest success: the shells having been spread to the extent of 30 or 40 bushels per acre, and the crops equalling those from *bone dust* or *farm yard manure*. Several trials were also made with wheat, the results of which have not reached me, but I have little doubt of their success. In Cornwall, the sand of the coast, which is chiefly composed of fragments of shells, is in great esteem, and extensively used. Such dressing is within reach of most West Indian Agriculturists; and either this or the calcareous sand of the Bahamas, spoken of by Mr. Lees,|| mixed with animal manure, would prove an invaluable dressing. || See page 32.

† Folding in the field will be the best practice in the West Indies, shifting the fold successively over the whole field, so as, with less labour, to give every part the full benefit of the dressing.

"Another valuable means of acquiring animal manure, is *Pig feeding* "and fatting, both of which I carry to a great extent, and fatten all I "breed. This practice is within the reach of every farmer who grows "Beans, Peas and Barley."*

Colonel Le Couteur strongly recommends KELP, to which his attention was directed by an old and experienced farmer, "who considered *Kelp*, "or the *Ashes of Rock Seaweed*, that which is cut, the best of all. "I am convinced, by subsequent experience, that two or three pounds "worth of it per acre, spread at the proper period, about two months "before sowing time, would *always more than repay itself*. It *attracts* "*moisture from the atmosphere*; it *materially increases the volume of the* "*grain*, and *fineness of the sample*; but it does not add to the weight of "the straw, though rendering it white, and *more nourishing to Cattle*. "It causes *Wheat to assume a rich and healthy appearance*, and is an "excellent application after a crop of Potatoes or Parsnips, both of "which require land to be richly dressed with stable and other strong "manures, and has not the effect of decomposing them as lime does. It "is also destructive to insects and to their eggs, which lie in the soil or "turf. It forces the earth worms and wire worms from their hiding "places, to come to the surface and die; particularly when laid on "in larger quantity than I have named."† In addition to these advantages, vegetable ashes, from the quantity of pure alkali which they contain, act by rendering the animal and carbonaceous matter, mixed with the soil, soluble in water, and thus present these elementary principles of vegetable organization to the minute fibres of the young plants in the state fittest for absorption. The utility of Alkaline salts in this respect, is strikingly exemplified by Mr. Young's experiments, recorded in the Annals of Agriculture; from which we learn, that with a mixture of 1 ounce of powdered charcoal, and as much pearl ash in solution, he obtained from 10 barley-corns 715 grains of corn and straw: with straw steeped for 3 days in stable urine only 473: with straw similarly steeped for 3 hours, 188 grains: and with ½ ounce of straw, cut fine, but *not steeped*, only 139 grains: shewing a superiority of no less than 5.14532374 to 1, in favour of the Alkali.‡

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* The following is a tabular statement given by his Lordship, of the produce per acre, and price per quarter for each of the 7 years, commencing with 1832:—

Years.	Average Produce per Acre			Price per Quarter	
	Quarters	Bushels	Pecks	Shillings	Pence
1832	4	6	1	55	1¾
3	3	3	3	49	5¼
4	4	..	1	40	11
5	4	2	3	44	10¼
6	5	2	3	56	5
7	5	..	..	61	..
8	4	3	..	71	2
Average	4	3	3	54	1½

† Varieties, &c. of Wheat, p. 47 and 48.

‡ The minute scale of Mr. Young's experiments rendering them easy of repetition, I am induced to transcribe his method, for the benefit of such as may wish to repeat

Next to KELP, the Colonel says,* " I am inclined to believe that " *Paring* and *Burning* an old ley will produce an equally good effect, " *where the land is suited for it*:† for, although the ashes may not be of " that superior quality, or possessing all those virtues peculiar to *Kelp* " *Ashes*, still the much greater portion of ashes that can by this means " be spread on the land, may make amends in *quantity* for *quality*. An " additional circumstance in favour of *Paring* and *Burning* is, that all " *the seeds of weeds*, or *eggs of insects which lie concealed in the turf*, " *are thereby destroyed more effectually than by repeated ploughings.* " The careful experience of 5 years on this head, has convinced me of " the propriety of this practice occasionally; especially on ground " infested with *Couch* or *Knot Grass*," (the *Strawel* of Devonshire, or *Triticum repens*.) In St. Kitts many valuable sugar estates have been abandoned from the plague of the *Nut Grass* (*Cyperus Hydra*) tenfold worse than the *Strawel*; and for which no remedy has, as yet, I believe, been found. The evil might perhaps be mitigated by repeated deep ploughing in the driest and hottest weather, aided by hand-picking as many of the tubers as possible, and burning, after thoroughly drying them in the sun: operations which would give suitable employment to women and children. In further proof of the utility of *Paring and Burning*, the Colonel informs us, that " from 3 acres of land that had " been pared and burned, which produced 540 single horse-loads of " ashes," he, " obtained a very heavy crop of Turnips. The following " year," he " raised 9400lbs. of Potatoes; and by an application of " about 45 bushels of lime per acre," he has " since reaped 51 Imperial " Bushels of Wheat per acre; the straw was also of very fine growth, 5 " feet high, and exceedingly white and bright." With respect to kelp, or other ashes, he gives a caution equally applicable to Lime, namely, to spread them on the ground 1 or 2 months before sowing,

them. Having procured a number of flower pots, as nearly equal as possible, 6 inches in depth, and as many in diameter, he filled them with an equal quantity of mould, adding to each one of the different substances proposed as manure, and then planting 10 grains of barley. To obtain the relative value of each, he added together the number of grains of Corn, and weight of Straw obtained. It would have been more satisfactory to have noticed in the first instance the weight as well as number of the seed, and afterwards weigh the straw, ears, grain, and roots, well cleansed from adhering soil; the difference of weight would mark the true amount of increase. It would add further to the value of the experiment, to plant but one, in place of ten grains, in each pot, and note the difference of increase by tillering.

* On the Varieties, &c., of Wheat, p. 40.

† All soils are not equally adapted for this operation, by which much vegetable matter is lost. In cold clayey soils, the earth burnt with the sods is converted into a kind of sand or brick dust, insoluble in water, which corrects the too great tenacity of the clay, and changes it into more or less of a loam. On such soils *Paring* and *Burning* yields the double advantage of the burnt clay and the ashes; and if the burning has been conducted by a *smothered combustion*, much of the vegetable matter will be retained in the shape of charcoal. On other soils, however, it is often decidedly injurious. To determine the fitness of a soil for burning, expose a few sods to a heat sufficient to burn them without the production of light, in an iron pot or crucible closely covered, till the sods are consumed. If the ashes which remain are red, mixed with particles of charcoal, and especially if they form a muddyish water, and the earth does not readily fall down, the soil, whence it was taken, may be advantageously burned. But if it feels gritty, lets the water readily through, and falls soon to the bottom, on being mixed with it, burning will be injurious.

that their causticity may be mitigated by the absorption of carbonic acid; and the danger thus removed of burning the tender shoots of the grain, along with the larvæ of insects. To aid this, they should be turned over occasionally so as to expose a fresh surface to the air, or ploughed lightly into the soil. He then continues, "I am so partial to the use of "ashes, that I would recommend those who have large woods or "forests, to employ women and children, to collect the dry and broken "boughs, and under shrubs, to be burned for the sake of the ashes, "which would be found *nearly* equal to that of sea-weed, and could "be procured at *a much cheaper rate;* besides converting what is now "wasted or neglected, into a most valuable and permanent manure, "perfectly free from weeds, and destructive insects and worms."

Many West India Islands, as Dominica, Nevis and St. Kitts, are infested with thorny *Mimoseæ* (as the *Acacia tortuosa,* or *Common Cashaw*) which rapidly overrun the pastures or other ground not under immediate tillage, and become a perfect nuisance. These might be readily converted, by burning, into an inexhaustible supply of the most valuable manure, and thus become a source of the greatest profit.

The nature of the dressing should, however, be varied with the composition of the soil; it being the object of the scientific agriculturist to *aid* nature, not to *counteract* her; to *supply deficiencies*, not *create redundancies.* He should therefore carefully examine the soil, to ascertain which of the necessary constituents is deficient, before he applies a remedy; lest, by acting empirically, he should defeat his object, and augment, in place of diminishing, preexistent defects. In Antigua, for example, we meet 2 distinct kinds of soil, each requiring, to a considerable degree, an opposite description of dressing: 1st, *a rich black mould* resting on a substratum of clay. This, *from its colour,* may be presumed to be rich in decayed vegetable matter or *Humus;* and hence would probably receive the largest amount of improvement from *lime,* or the *calcareous sand of the soil;* such especially as that already spoken[*] of as abounding in the Bahamas; while animal manure should be used more sparingly. In the 2nd description of soil, a *stiff clay,* resting on a substratum of marl, a free admixture of both calcareous and siliceous sand, would be proper, to disintegrate the soil; while decayed animal and vegetable substances are indispensible to give a due amount of fertility. Ashes, either marine or terrestrial, would be beneficial to both.

CARBON, or *vegetable coal,* is the essential basis of all vegetable matter; and, where not naturally present, must, in some shape or other, be artificially supplied; as has been clearly demonstrated by Hassenfratz, Kirwan, Davy, Murray, and others, who have treated of Agricultural Chemistry. "Coal," says Kirwan[†], "not only forms the residuum of "*all vegetable substances* that have undergone a *slow and smothered com*"*bustion;* that is, to which the free access of air has been prevented[‡];

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[*] See page 33 note.

[†] Essay on Manures, page 34.

[‡] When air is freely admitted during combustion, the carbon passes off into the atmosphere in the shape of gas, leaving behind little more than the alkaline earthy, and perhaps metallic constituents of the vegetables. But where the combustion has been conducted, as in the manufacture of charcoal, *without the free access of air,* this waste is in a great degree prevented. and the carbonaceous particles being blended with the

“ but also of *all putrid animal and vegetable bodies* that have undergone putrefaction, and it is the true basis of their ameliorating powers. If the water that passes through a putrifying dunghill be examined, it will be found of a brownish colour; and, if subjected to evaporation, the *principal* part of the residuum will be found to consist of coal. All soils steeped in water communicate the same colour in proportion to their fertility; and the water, being evaporated, leaves also coal, as MM. Hassenfratz and Fourcroy attest. They also observed, that *shavings of wood* being left in a moist place for 9 or 10 months, began to receive a fermentative motion, and, being spread on the land, putrified after some time, and proved an excellent manure.” *Sawdust* acts in a similar manner, and being more minutely divided, would produce an ameliorating effect *sooner*, although perhaps less permanently. Murray[*] also observes, that the fertility of a soil arises from the quantity of decaying animal and vegetable matter it contains, ceasing when this has been expended, and renewable only by the introduction of a fresh supply. “ This, therefore,” he adds “ forms the *first* and *most important* of manures. Its nature must vary somewhat according to the intermixture of animal and vegetable matter; but it must always contain, in large quantity, the elements of which vegetable matter is formed, *and must consist almost entirely of these.* The black mould into which vegetable matter passes by slow decomposition, and which always exists more or less in the soil, consists principally of the Carbon which is the basis of that matter, with portions of other elements.....The great utility of vegetable and animal substances as manure undoubtedly consists in their affording matter *already assimilated*, and hence, more fit to serve for the nutrition of vegetables. The water, which is present, dissolves the mucilaginous and extractive principles, and, being absorbed by the roots, must afford more nutritious matter than water that is pure. Saussure found that water holding in solution various salts, as well as different vegetable substances, gum, sugar, &c., easily enters into the roots of plants by absorption; and that this absorption is, in some measure, elective, some substances being more largely absorbed than others.”

Upon similar grounds, my learned friend Professor Desvaux, Ex-Director of the *Jardin des Plantes* at Angers, gives the following advice well worth the attention of the West Indian Agriculturists. “ All the dung and litter of animals, and every refuse capable by decomposition of forming manure, should be kept as far as possible (240 feet at least) from the farmhouse and stables, and to leeward of the prevailing winds. They should be collected in a pit proportioned to the wants of the farm. The garden weeds, scourings of the ditches, and dung of the stables, form, when mixed together, a compost of more power than any of its components taken singly. By means of a pit, accessible on one side, the loss of those liquids is prevented, which are usually left,

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caustic fixed alkali, become soluble in water, and are thus presented to the minute fibres of the roots in a state fit for absorption by the spongioles placed at their extremities.

[*] System of Chemistry, vol. 14. chap. 1, p. 90. Edin. 1807.

“ from ignorance, to be washed away by the rain, lost by evaporation, or “ carried off by the streams traversing the villages, occasioning a serious “ waste of much of the fertilizing principles.”[*] For the farther preservation of this liquid and more valuable portion from loss by absorption, he recommends, in all practicable cases, lining the bottom and sides of this foss with *clay* rather than *stone;* as the clay, when saturated with the absorbed liquid, becomes in itself, without farther preparation, a valuable manure.

“ When urine, and a considerable portion of the solid dung, are washed “ into a reservoir immediately from the stables, its strength can be much “ more readily ascertained, than when they are mixed with straw, and “ thrown into a yard. The specific gravity is readily obtained by an “ instrument, and those who are in the habit of observing this liquid “ manure, can judge more accurately of its strength, and the degree of “ putrefaction which it has undergone. Notwithstanding some apparently “ contradictory statements, it is pretty generally acknowledged by those “ who have had long experience of its use, that *urine,* and *similar animal* “ *substances,* have *a more powerful effect* on the soil, *when they have* “ *undergone a certain degree of putrefaction,* than when they are used “ in a fresh state, and that this is produced with the *least loss of* “ *substance,* when the liquid has been confined in *close vaulted cisterns,* “ which *admit the air only partially.* On *light soils*[†] this liquid has a “ most fertilizing effect, if used *frequently,* and *in small portions at a* “ *time.* On *very heavy soils,*[‡] this effect is not so apparent; and for “ *such soils,* the liquid is accordingly *mixed with sand,* or *any light* “ *earth* before it is applied; or, instead of using it at once upon the “ land, it is poured over the litter, which has been collected in a heap or “ in a yard, after having served for the cattle. This litter, having been “ deprived of the urine which would have mixed with it, would rot very “ slowly, and produce a very inferior kind of manure, unless it were “ moistened, and fermentation[§] excited by pouring the half putrified “ urine over it. It may be objected, that if the urine is only collected “ to moisten the straw which has served as litter, it would be as well to “ let it be mixed at first without the trouble of pumping up, and the

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[*] “ Tout ce qui sort de dessous les animaux, et tous les débris, susceptibles, par leur de- “ composition, de former engrais pour les terres, doivent être tenus le plus loin possible “ (30 toises au moins, ou 60 metres) de la maison d'exploitation, et de l'étable des “ animaux, et sous le vent qui souffle le plus habituellement. On doit reunir “ l'ensemble dans un fosse, de grandeur proportionnée au besoins de l'exploitation. Et “ des herbes de jardin, des terres de déblais, des fumiers des étables, ont forment un “ compost qui, *dans son ensemble,* produit *plus d'effet que chaque chose utilesée isole-* “ *ment.* Par le moyen de le fosse, abordable d'un côté, on evite la perte des sucs qui, “ *par imperitie,* sont ordinairement ou entrainées par les eaux, ou évapores, ou aban- “ donnees en eculemens dans les ruisseaux des rues de villages; et de là une perte “ importante d'une grande partie des principes fertilisans.” *Precis d'un Cours d'Agriculture generale, Institutions Agricoles appropries à toute les intelligences.*—Paris, 1832.

[†] As in New Providence, &c. [‡] As in some parts of Antigua, Nevis, &c.

[§] “ According to the most recent discoveries of chemists, the nutritive matter of all “ vegetables is contained in globular bodies so small as to be invisible to the naked eye. “ These globules afford no nourishment till they are broken, and this can only be effected “ by heat, either that of the stomachs of animals, or that produced by boiling and

“ expense of a cistern to hold it,—but we shall soon see that there is *a very*
“ *wide difference.* In the common method of collecting farm-yard dung
“ the straw is very unequally impregnated with animal matter ; at *one*
“ time it will contain a large portion, and run rapidly into fermentation ;
“ at *another*, there will be so little, that it is with much difficulty heat is
“ excited in it. By separating the urine and litter, the straw will go
“ much further, and can be mixed *at the most advantageous time ;* thus
“ it forms a *much richer* manure in a *smaller* compass, from not being
“ so much diluted with water. Should there be a deficiency of straw,
“ *earth* or *sand* will supply its place in as far as sucking up the rich
“ juices : for the addition to the manure, from the decomposition of the
“ straw itself, is very small in proportion to that which the animal juices
“ afford. If the liquid is collected from a stable or yard, as soon as it
“ is produced, and carried off into a cistern, there will be a *much drier*
“ *bed* for the cattle, especially if the rain is kept off by light shades.
“ Where the litter is soiled to a certain degree, it may be removed to a
“ heap in a proper place, where its conversion into dung may be effected
“ by the addition of putrifying urine, than which nothing will so soon
“ rot vegetable fibres, *if the air be admitted to the heap.* The portion
“ which is not wanted for some time, may be left to decompose more
“ slowly ; and, as the time approaches when it is wanted for the land,
“ it may be managed so as to be in that state, which experience has
“ shown to be most effective in the improvement of the crops....The
“ great use of liquid manure on *light soils*, is to impregnate them with
“ soluble matter which, being diffused through their substance, supplies
“ nourishment to the roots of the plants wherever they may shoot out. It
“ may be applied to the land *at any time before* the seed is sown, and *soon*
“ *after* when the blade springs up, or the seed begins to form* : in
“ short, *whenever the plant requires fresh nourishment*, or when *that*

“ cookery. The nutritive particles of manure are exactly of the same description as
“ those of food, and can only be burst open by the heat of fermentation, or by chemical
“ decomposition. We learn from these facts the importance of cookery, of fermenting
“ manure, by mixing soils and manures of different kinds together so as to induce
“ chemical action. The reader will find a valuable paper on this subject in the Q.
“ Journ. of Agric. vol. 13. p. 145. and another on the subject in the Jour. of the
“ Franklin Institute, for November, 1838, p. 333. In an interesting paper ‘ on the
“ part which soil exerts in the process of vegetation’, read at the Academy of Sciences
“ by J. Pelletier, the Author endeavours to show that the fertility of a soil depends on
“ the *complexity* of its composition : in consequence of which an *electro-chemical* force
“ is produced, which acts at once on the soil and vegetation. According to this theory,
“ 3 primitive earths are essentially necessary to the composition of a good soil.”—
Gard. Mag. vol. xv. p. 186.

* Much judgment, and careful experiment are required to determine the fit stage and proportions in which liquid manure should be applied ; since an error in either respect may be very injurious, as Col. Le Couteur fully shews in his chapter on
“ *Manure for Wheat,*” in which he says : “*Liquid Manure,* one third stable dung,
“ and two thirds water, which I caused to be poured once over wheat *that was just*
“ *tillering,* made the straw grow rank and coarse ; the grain of every variety of wheat
“ was dark and thick skinned, hence containing less meal. The same quantity, poured
“ a second time over another portion of the wheat, caused it to grow so rank and full
“ of leaves, that only a few of the plants produced ears of wheat, some having run up
“ into sharp points with merely the rudiments of ears indicated....The wheat on
“ either side of these experiments, *which had been manured with the ashes of Kelp, or*
“ *Seaweed,* was healthy, productive, and farinaceous in the highest degree”. p. 46.

"*which existed in the soil is diminished.* Without *liquid manures* the "poor siliceous sands of Flanders could never be cultivated, much less "produce crops which vie in quantity and quality with those on the best "soils. The quantity of farm-yard dung in a rotten state, which this "soil would require, according to the common system of manuring, "could never be produced by all the straw which can be raised upon it "in its first state of cultivation. But cattle produce urine, and this "produces roots for cattle." *

BONE DUST has been highly extolled, and extensively employed of late years, especially for Turnips. It is a dressing easily obtained by the preservation of the bones of the meat consumed in the family, which only require to be broken small. We learn from the Gardener's Magazine,† that its effects "in the cultivation of the soil are *really astonishing.* "A gentleman who used the dust of *boiled bones,* on a *very dry soil,* "declares that its effects were visible three weeks afterwards. *Boiled* "bones were but *half the price* of other bones, while they came *much* "*sooner into operation:* and a friend had assured him, that a field which "he dusted *five years ago* with *boiled bones,* was quite as good as in the "first year." My limits will not allow me to enter into the theory of these effects, farther than to express an opinion that they result chiefly from the moisture retained by the fragments of the bone, which is thus saved from waste by evaporation: this, in arid soils and dry seasons, will afford nutriment to the roots, and preserve the verdure of the plants unimpaired.

NITRATE OF SODA is another substance which has been tried, and according to the Falmouth Packet of the 1st of February, 1840, with such advantage, as to throw the question of cost‡ entirely into the shade. "In March, 1839, Mr. John Ryde, bailiff to F. Mangles, Esq., of "Down Farm, near Guildford, Surrey, dressed several acres of wheat "with *Nitrate of Soda,* in the proportion of 1½ cwt. to each acre, "leaving about half an acre in the centre of the field undressed. In "10 days the effect was perceptible in the colour of the wheat; and, "when ripe, the straw of the wheat dressed with the *nitrate,* was not "only *longer,* by 9 or 10 inches, but *stronger.* When the field was "reaped, 7 rods of both the dressed and undressed were measured, cut, "and kept separate. The portion, *dressed with the nitrate,* produced "24 sheaves, yielding 81 gallons of wheat, and 54 lbs. of straw, while "the *undressed portion* yielded but 10 sheaves, producing 61 gallons of "wheat, and 40 lbs. of straw." The nitrate acts probably not so much by entering into the circulation of the plants, as by increasing the solubility of the oleaginous and other nutritive matter contained in the soil, and thus fitting them for absorption by the spongioles. It may also act by yielding an increased supply of oxygen, (which nitrates part with more readily than other salts,) and thus exciting a more healthy and vigorous vegetation. The effect in this case was to increase the number of sheaves 240 per cent.; the measure of grain above 132 per cent.; and the weight of straw 135 per cent.

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* Penny Cyclopedia, vol. xiv. p. 329. Art. "MANURE." † Vol. xv. p. 967.

‡ The price of Nitrate of Soda in the London Market is about 19s. per ton.

§ 3.—*Of the Choice of Seed and Method of Planting.*

A careful selection of seed, all of the same variety, is of the first importance; since different varieties come to maturity at different times: hence, to secure uniformity in ripening, the seed should be all of that variety which comes to maturity in the same interval. Victoria Wheat ripens in an average space of about 90 days; and hence, notwithstanding the smallness of its grain, which no doubt admits of improvement, is perhaps the best adapted for West Indian Agriculture. Other varieties may be more productive, but we are too little acquainted as yet with their fitness for a tropical climate to depend upon them: although, as that which was tried in 1494, was direct from Europe, there seems no reason why other sorts, especially from the Southern parts of Europe, should not equally answer on their first introduction if planted at a fit season. The Anti-Corn Law Circular of 20th August, 1839, upon the authority of the Boston Herald, mentions a variety well worth trial if it could be obtained. " Mr. Mumford, a gardener of Boston, has now in culti-" vation a most extraordinary species of wheat, such as is not to be " found in any other part of the country. The ears average about " 1¼ inch in circumference: 1 peck of seed is amply sufficient for an " acre, the yield from which is truly astonishing. Notwithstanding the " high winds and heavy rains which have prevailed, this surprising " wheat has not sustained the least injury. The *whole* of the present " corn is the produce of a single grain, which was sown by Mr. Mumford, " 3 years ago."

Col. Le Couteur instances a plant from a single grain of the downy variety, which " in 1833 threw out 32 tillers: all produced ears, with " an average of 50 grains to each, or 1600 grains from one: an enormous " produce which," he thinks, " no field cultivation could be fairly expec-" ted to attain." He adds, that " the average tillering on that productive " variety, was 15 on 40 plants, clearly evincing a prolific habit which " has since been established." Col. Le Couteur informs us that he *generally*, but not *invariably* found, that the grain of white corn was the plumpest, the heaviest and the most farinaceous: and he seems to think the *white sorts* will succeed best on dry soils, and in warm climates. If these opinions prove correct, the *Talavera*, and other finer Spanish Wheats may hereafter be found fittest for tropical culture: but in the present state of our knowledge, the Victoria seems best suited for extensive cultivation. But whatever the variety selected, there can be no doubt of the soundness of the advice given by Columella, to choose the *largest* and *heaviest* grains for seed: advice in strict accordance with what Virgil says

> " Vidi lecta diu, et multo spectata labore,
> " *Degenerare* tamen; *ni vis humana quotannis*
> " *Maxima quaque manu legeret.*"—Georg. i. v. 197.

This may be effected by a sieve through which the smaller grains will pass, leaving only the best and most farinaceous behind.*

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* It is a practice among gardeners who are desirous of improving the quality of their flowers, to select for seed those that possess the largest aggregate of good qualities; and the same rule will no doubt be found to hold good with respect to Wheat and other grain—hence it will be desirable to select for seed not only the plumpest and heaviest grains—but those which have been obtained from plants of the most prolific habits. —The Globe, of the 28th of August, 1840, notices, upon the authority of the Worcester

As to *Season*, present experience seems to recommend that selected in Venezuela, namely between Christmas and Lady day; the crops, then sown, appearing to ripen in a shorter time, and to be exposed to fewer casualties.

Wheat may be advantageously planted, as Mr. Young has shewn, in the rows between the young canes, effecting a vast saving of ground, labour, and manure. The wheat, ripening its crop in about 90 days, will be fit for cutting, before the cane attains such a growth as to overpower it; while the broad foliage of the cane serves to protect the roots of the wheat from drought. But whether the seed be thus planted, or alone, dibbling it in holes from 4 to 6 inches deep, and at least 12 inches apart, will be found the best method, both as employing less seed, yielding a heavier crop, and affording profitable employment to the aged and infirm, to women and to children: leaving the able-bodied labourer, for the more fatiguing operations, at a higher rate of wages. Dibbling varies, in different parts of England, from 6s. to 10s. per acre, according to the nature of the soil, and local circumstances.

In Norfolk, where the wasteful practice of sowing by broadcast has been long abandoned, the drill and dibble are alone employed, saving half the seed, and, at the same time, augmenting the return; 1½ bushel of seed being sufficient, by either method, for an acre of ground, in place of 3. When sown thick, as in broadcast, the strong plants overpower the weak, depriving them of their fair proportion of nourishment, and excluding from them their just share of light and air: while the disposition to tiller is counteracted by the closeness of the roots. In Norfolk the excess of return, exclusive of the saving of seed, is estimated at no less than 4 bushels an acre, worth at 7s. 6d a bushel, £1 10s. But by dibbling in at intervals of 12 inches, with a single grain in each hole, which Mr. Young deems sufficient, not only will the saving of seed be infinitely greater, but the roots, having a wider range for nutriment, will yield stronger plants and more numerous tillers. A striking proof has been already given, in the note at page 56, of the benefit of dibbling the grain in holes *not less* than 3 inches deep, while the experiments detailed below,* favour the practice of *wide* intervals, and *single* seeded holes. If a grain of wheat, planted at some depth below the surface, be taken up after the appearance of its second leaves, it will be found to possess

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Journal, an ear of wheat found at Haslingden, which contained 153 grains; and another, growing upon a stalk 8 feet high, in a garden in the Phœnix park, near Dublin, which contained 650 grains The seed of these ears, if planted separately, might be expected to retain the same prolific habit for a considerable succession of generations: and hence by careful attention to the character of the parent stem, as well as the size, weight, and plumpness of the grain, prolific varieties may not only be perpetuated but improved to perhaps a centuple degree.

* These were made by Mr. Martin, of Stoke, near Guildford, who planted, in one experiment, holes, placed at intervals of 4 inches, with 1, 2 and 3 grains of wheat each: and, in another, holes, 6 inches apart, with a single grain. From 29 plants, from as many grains, planted singly in holes 4 inches apart, he obtained 216 ears, being an average of 7.4483, from each: from 20 grains, set doubly at the same interval, he obtained 137 ears, or 6.95 from each: and from 23 grains, 3 in a hole and 4 inches apart, 198 ears, or 8.6 from each: certainly showing an apparent gain from increasing the number of seeds: but since the double seeded holes exhibit a falling off in the number of tillers as compared with the single, we may reasonably suspect some undetec-

two distinct classes of roots,[*] separated from each other by the *depth of the grain below the surface,* and connected by, what has been appropriately termed, the "*Pipe of Communication.*" Of these the deeper proceed from the grain itself, and are termed the "SEMINAL ROOTS"; while the more superficial spring from the crown of the plant, and are hence distinguished by the name of the "CORONAL ROOTS." These are not produced till the *crown,* which is *always found just below the surface,* has attained sufficient size. It is this admirable provision which enables this valuable plant to adapt itself to almost every vicissitude of climate and weather which the human constitution is capable of enduring. From hence we learn the value of top dressing, which serves at once to check evaporation, and furnish nutriment to the spongioles of the superficial roots: together with the importance of placing the seed, in warm countries, light soils, and dry seasons, at *such a depth* as may secure it at once from the depredations of birds or insects, and *the influence of droughts.* Col. Le Couteur objects[†] indeed to a greater depth than 3 or 4 inches; but this applies to a cold climate, stiff humid soil, and wet season. We have more to apprehend, within the tropics, from *superficial,* than from *deep* planting: provided the depth be not such as to exclude the access of air, so essential to germination. What this should be, must vary with the nature of the *climate, season,* and *soil,* and be determined by experiment. Although Col. Le Couteur's wheat, when planted at a depth of 7 or 8 inches, for the most part perished from the cold and humidity of the spring, it is more than probable, that, had Mr. Lees adopted an equal, or even greater depth, he would have secured his grain from the ravages of the torrents which accompanied the hurricane of 1838, and been enabled to make a far more favourable report than he did. In such soils indeed as that of the Bahamas and Bermuda, deep planting appears indispensible to success.

§ 4.—*Of the Rotation of Crops.*

Farmers have long known that a continued succession of the same crop from the same ground, was attended with a progressive degeneration of the produce; rendering a temporary repose, or what was termed *fallowing,* indispensible. This was ascribed, in the infancy of our acquaintance with vegetable physiology, to an exhaustion of the food adapted to the nutriment of the plant, which required time for its reproduction; but, as the system of fallowing was attended with no small loss to the cultivator, it was attempted to renew the productiveness of the soil by artificial means, without having recourse to fallows.

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ted cause for the difference of the result from that obtained with the 3 seeded holes; especially when we look to the series of experiments with *single* seeded holes at an interval *one third greater.* In this case he obtained a return of no fewer than 236 ears from 10 plants, or 23.6 from each, being nearly treble the increase from the three seeded holes: and shewing, that the largest amount of return was obtained from the *smallest* expenditure of seed, planted at the *widest* intervals. Why this should be so, may be collected from what is said above.

[*] See Colonel Le Couteur's Work, p. 30, 31, 32, and 33.

[†] See Colonel Le Couteur's Work, p. 33.

These, however, not being found successful to the extent expected, a suspicion arose, that to the *abstraction of nutriment*, might possibly be added an *accumulation of excrementitious matter* from the roots; a fact which derives strong corroboration from the observations of M. Sylvestre, and the experiments of Mr. Payen detailed in the note.* It next occurred to experimentalists, such as the illustrious De Candolle, that the excrementitious matter of one class of plants might furnish wholesome aliment to another; a conjecture which has become strengthened by the test of experiment. Thus gardeners have found, that after young potatoes have been cleared from the rows, and the ground well dug in the form of shallow trenches and manured, Spring Broccoli may be advantageously transplanted into the trenches, flourishing greatly after this plant, as wheat does, upon a large scale, in farming. The excrementitious matter of the Parsnip, as well as that of Flax, and the Potatoe, has likewise been found favourable to a good crop of wheat, if put in soon after they have been severally removed. Such is the principle upon which the valuable system of the rotation of Crops is based, by means of which not only the practice of fallowing is done away, but the success of one crop ensured by that which preceded it. Upon the skilful application of this system rests nearly the whole science of modern Agriculture.

Flanders, which, under all the disadvantages of a sterile soil and a rigorous climate, presents the best and most productive system of tillage in Europe, strikingly exemplifies the results of a nice adaption of the cycle of crops to the peculiarities of the soil. This consists of two sorts, the alluvial clays of the coast, and the lighter loams of the interior. The former, which is the most fertile, is found in the low lands reclaimed from the sea, and consists of muddy deposits mixed with sea sand and broken shells. These lands are called the "*Polders*," and are tilled with less care than the more unpromising lands of the interior; hardly requiring manure, and even sparing the ashes of their weeds to the cultivators of the more sterile tracts. It is upon these last that the triumph of art, of industry, and of science, over the stubborn obstinacy of nature, is most signally displayed.

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* "It has been repeatedly stated by Mr. Silvestre, jun., that trees soon died when their roots came into contact with the remains of the roots of oak trees cut down near them. This was supposed by some to be owing to the action of tannin, while others maintained that it was innocuous. M. Payen instituted direct experiments on this subject. In order to observe the influence of tannin, and to appreciate its effects comparatively with those of other agents, M. Payen placed grains of wheat, rye, barley, oats, and maize, in contact with equal quantities of the following liquids, and all other circumstances were equal. 1st, aerated distilled water; 2d, the same containing 0.01 of its weight of a saturated solution of carbonate of soda; 3d, the same containing only 0.001 of its weight of the same saturated solution of carbonate of soda; 4th, a solution containing 0.001 of pure tannin; 5th, a solution containing 0.001 of sulphuric acid; 6th, distilled water saturated with lime. In the distilled water, in the liquid containing 0.001 of solution of carbonate of soda, and in the solution of tannin, germination took place in the order stated; in the other three liquids, those containing 0.001 of acid, 0.001 of carbonate of soda, and saturated with lime, germination did not occur. The distilled water became slightly acid. The development of the stalks, at first rather more rapid than in the solution of 0.001, of carbonate of soda, slackened comparatively with that which occurred in the last liquor: when this was neutralized by the acid excreted by vegetation, the original quantity of alkali was added. In bitter liquids the white roots and green stalks were several centimetres long in a fortnight. In the solution of 0.001 of tannin, all the radicals gradually acquired a brown tint, and were but slightly and imperfectly developed. The plumulæ continued whitish, but did not develop any green stalks; there was therefore a strongly marked obstacle to any further development in this liquid. M. Payen concludes, from the preceding and other experiments, that—1st, Tannin, even in small quantity, acts deleteriously on the roots of certain plants: 2dly, Acids in small proportions are hurtful to germination: 3dly, Alkalies in small quantity are favourable to the progress of vegetation: 4thly, the saturation of the acidity developed during germination hastens its progress and favours the ulterior development. These experiments account for one of the useful effects of lime, of vegetable ashes and calcareous marl, and for the unfavourable influence of alkalies used in too great quantity, or unequally distributed."—*Journal de Chimie Médicale. Avril*, 1834. See also Mr. Lymburn's valuable remarks on the germination of seeds. in the Gard. Mag. vol. xvi. p. 436, and seq.

" The rotations adopted in light sands and loams are various. In the " poorest and least improved, *Buck Wheat*, *Rye*, and *Oats*, are the " chief crops, with *Potatoes and Clover*, which require more manure. " Every crop is manured except *Buck Wheat*, which grows in the " poorest soils, and becomes too luxuriant to give much seed in rich and " highly manured lands. *Bones* have not been introduced, except by " way of experiment: but when their value on light soils shall be more " generally known, especially in raising Turnips, there is no doubt but " they will be more extensively used. This may lead to folding sheep " to eat them upon the land, and thus, introduce an important improve- " ment into Flemish husbandry."*

The practice here suggested, might be advantageously adopted in the West Indies, by planting the Bengal Bean (*Psophocarpus tetragonolobus*) and similar plants to be eaten off by sheep†.

" On the lighter kinds of soil, which are not well adapted for wheat, " the usual course is, 1st Rye, with Turnips the same year after the Rye " is cut; 2nd, Oats; 3rd, Buck Wheat; 4th, Potatoes or Carrots; " 5th, Rye and Turnips; 6th, Flax; 7th, Clover. When the sand " becomes a good light loam, Wheat is introduced in the rotation after " Potatoes, or after Clover. The latter is thought to be the best " practice, as the roots of Clover both enrich and consolidate the soil."

The *Trifolium incarnatum*, already tried in Jamaica, if sown at the commencement of the rainy season, so as to establish itself before the dry one sets in, might supply the place of other Clover in a system of West Indian rotation; the climate differing little from the temperature of the Italian summer, while its yield of fodder is immense. It will be seen, however, from Dr. Bancroft's report below, that it is extremely impatient of drought; rendering a reserve crop in a moist situation indispensable.*

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* Penny Cyclopedia, vol. x. p. 301. Article " FLANDERS."

† This plant flowers in August; if sown *after this period* it will continue to spread without flowering, and cover the ground with its dense herbage till August again comes round. Hence, to obtain the full benefit of it as a green crop, it should be sown in Sept., Oct., or Nov.; and would be fit for cattle to feed on, in Dec. Jan. or Feb. The ground thus manured, without any other preparation than ploughing, would then be ready for a crop of Wheat. Cattle devour it with avidity. The African Spinach (*Basella alba* et *rubra*) is another plant, equally good for the table, and for fodder, which might serve the same purpose; as it withstands the severest droughts, screens the earth from the sun, and improves the milk of cows fed on it, both in quantity and quality. It is surprising its good qualities should have been so long overlooked in the West Indies.

" *Rye* returns more frequently than would be thought prudent, if it " were not for the Turnips sown after it, which seem to correct the effect " produced on the soil by the seeding of the *Rye*, in which *Clover* is sown " in the next spring. Thus *Rye* and *Turnips* may alternate in light " lands, as *Beans* and *Wheat*, sometimes do in heavy rich soils. The " *Turnips* are never eaten on the land where they grow, but are always " drawn and housed in the end of September, the green tops being cut " off and given to the Cows and Pigs, and the roots stored in dry " cellars. The land is immediately ploughed after some dung has been " put on; and if *Oats* are the next crop, which is sown in Spring, it " remains so all the winter. When the land is of a better quality, " although still in the class of light loams, *Wheat* returns more frequently " and the rotation is varied as follows. *Rye* and *Turnips, Potatoes,* " *Wheat, Rye* and *Turnips, Oats, Flax, Clover, Wheat.* If the soil is " fit for *Barley,* this grain is substituted for *Rye. Carrots* are " frequently sown in *Barley,* and also in *Flax.* They strike deep into " the rich light earth, but come to no size while the principal crop is on " the ground. As soon as this is taken off, the land is harrowed, " carefully weeded by the hand, liquid manure, diluted if the weather " be dry and warm, is spread over the surface, and in a short time the " *Carrots* throw out their green tops, and swell in the ground; and " by the end of September a considerable crop of them may be dug up. " The best variety for this purpose, is *a large white Carrot,* which rises " some inches out of the ground; it has lately been brought into notice " in England, and will no doubt soon be more generally cultivated. " The quantity of roots raised for the winter provision of the cattle is " considerable, and forms a very important part of the husbandry of " Flanders, where all the cattle are constantly kept in stables in " winter; and, *except where there are natural pastures,* in summer also.

" In the heavier loams, which are chiefly to be met with in West " Flanders, and about Alex, the following rotation is adopted:—*Flax,* " *Clover, Barley* or *Oats, Beans, Wheat, Rye* and *Turnips, Potatoes,* " *Colza, and Carrots, Flax.* Or, *Flax, Colza, Wheat, Rye and* " *Turnips, Oats, Clover, Wheat, Rye. Beans* are not a favourite " crop, and are not carefully cultivated. They are sometimes sown " very thick with *Peas* and *Tares,* to be cut up in a green state for cows " and pigs; and, in this way, they produce a great quantity, and clean " the ground by excluding the air. In a very heavy rich loam, not far " from Ypres, the following crops were noticed in regular rotation:—1, " *Turnips,* with *Chicory* and *Carrots;* 2, *Oats;* 3, *Clover;* 4, *Wheat;*

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* Of this we have the following report in a letter from Dr. Bancroft, of the 9th July, 1835. " *Trifolium incarnatum.* This has been sown in various situations with " unequal success. A considerable patch was planted at *Fair Hill,* in St. Andrew's " mountains, at an elevation of about 2,000 feet above the sea, and it seemed to be " doing well for a time; *but there supervened dry weather during a few weeks,* which " destroyed the whole, not a plant having escaped. But at another spot named *Charlottenberg,* with an elevation of 4,000 feet, the plant has grown and flourished luxuriantly, and has since been in seed." The mean annual temperature of such elevation corresponds closely with that of an Italian summer.

“ 5, *Flax*; 6, *Wheat*; 7, *Beans*; 8, *Wheat*; 9, *Potatoes*; 10, *Wheat*;
“ 11, *Oats*. All these crops are of an exhausting nature, and it requires
“ a very rich soil, aided by abundant manuring, to bear this rotation for
“ any continuance; but each of these crops had a good portion of
“ manure. Great attention is paid to prepare the land, so as to secure
“ *a good crop from a small quantity of seed*. The seed usually sown in
“ Flanders is about *one third less* than in England, *even when the seed*
“ *is drilled*, which it *never* is in Flanders. The ground is rendered
“ mellow and rich by the tillage, and liquid manure; and the seed,
“ *which has been carefully selected*,[*] is covered by earth spread over it
“ with a spade; it is afterwards rolled, or trodden in with the feet.
“ Every grain vegetates; and, should there be any slowness of growth,
“ the *urine tank* supplies an excellent stimulant. It is on the springing
“ up of the blade, *after the farina of the seed is exhausted*, that the
“ liquid manure seems to produce its greatest effects. When the stem is
“ shot up, it may perhaps too much encourage the increase of green
“ leaves, and thereby hinder the formation of the flower and the seed.”[†]

Although the Flemish system may not, in all its extent, be suited for adoption within the tropics, it furnishes many valuable suggestions for the guidance of the intelligent agriculturist, who can be at no loss to modify them according to local circumstances. Thus the winter provision for cattle, how superfluous soever it may seem where the rigours of winter are unknown, is not perhaps more necessary in Flanders than in the West Indies, where natural pastures, in the agricultural sense of the term, are unknown, and where provender for cattle is of such difficult attainment.

What the order of rotation, and of what crops that order should consist, so as to be best adapted to a tropical climate, experience has yet to determine; many of the plants which enter into the European cycle being at present regarded as unfit for West Indian cultivation; as for example the Potatoe (*Solanum tuberosum*), which is said to degenerate after the first crop. In the Southern of the United States of America, *Indian Corn* (*Zea Mayz*,) is said to alternate advantageously with *Wheat*; and this crop might accordingly be tried in the West Indian cycle. But, if the common Potatoe be inadmissible, there are other plants of the same family, habituated to the climate, which merit a trial; such are the Egg Plant, or ‘Trabbà,’ the Balanges of the French (*Solanum Melongena*), and the *Tomata* or *Love Apple* (*Lycopersicum esculentum*.) The indifferent success of Mr. Gilbert's first experiment in Antigua[‡] offers very little inducement to try the Convolvulaceæ, since the *Sweet Potatoe* (*Batatas edulis*) which preceded the Wheat, gave little proof of ameliorating the soil. The *Eddoe* or *Tanier* (*Caladium esculentum*) and *Yam* (*Dioscorea*) whose tuberous roots resemble those of the Potatoe, merit a trial. While the *Carrot* (*Daucus Carota*), *Turnip* (*Brassica Napa*), *Beet* (*Beta vulgaris*,) *Mangold Würzel* (*Beta altissima*), the roots of which are so valuable for feeding cattle, are partially, at least, cultivated at present, and might easily be produced upon a more extended scale as rotation crops. *Flax (Linum usitatissimum)* deserves a trial, both for the sake of its fibre, so important in the linen manufacture, and its seeds so valuable for their oil and the cake remaining after its expression, which is so useful in feeding and fattening cattle. The *Vanglo*, or *Oil Plant* (*Sesamum Indicum*) long known in the West Indies, and highly prized in the East, with the Oil Plant of Chili (*Madia sativa*), might also be tried with advantage; and the *Parsnip (Pastinaca sativa)*, whose saccharine roots are so nutritive both for man and beast, if it answer in the West Indies, could not fail to prove there, as in Europe, a good preparatory crop for Wheat. Roots feed cattle, cattle yield manure, and manure, as Lord Western justly observes, is *essential* to the production of Wheat. The *Cane* itself *(Saccharum officinarum)* may prove a good preparatory crop, especially as the high dressing it requires could not fail to benefit the Wheat; this might succeed the first canes cut in December, and be ready for the sickle in time for the replanting of the Cane in March or April. Or, as in Mr. Young's instructive experiment,* the Wheat may be planted in the rows between the young canes, especially in dry seasons, when the vegetation of the cane is not so vigorous as to overpower it: but in wet seasons this practice might be less successful. A considerable demand has arisen of late in Italy for esculent oils, and attempts have been made to cultivate the *Earth Nuts* or *Pindars (Arachis hypogeia)* upon a large scale for the sake of their oil: these attempts, however, have been in a great degree abortive, from the effect of frosts; hence the cultivation of this useful plant upon *a larger scale*, for the supply of the Italian market, could hardly fail to repay the labour bestowed upon it: while, as a preparatory crop for wheat, it could not prove otherwise than beneficial. The various other leguminous plants, in ordinary cultivation in the West Indies, as the Calavances *(Dolichos sphærospermus)*, Caripe Kidney Beans† *(Lablab purpureus)*, the different varieties of *Phaseolus*—the *Voandesia subterranea*, or Earth nut of Surinam, the *Bengal Bean*, already spoken of, and a multitude of others, tedious to enumerate, but familiar to every West Indian Reader, would also furnish an almost inexhaustible supply of crops for the rotatory system; which is the only one upon which European Agriculture can be successfully practiced.

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[*] See page 78.

[†] Penny Cyclopedia, vol. 10, p. 301, Art. “FLANDERS.”

[‡] See page 41.

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* Page 55.

† These are cultivated in the valley of Caripe, and, most probably in other parts of the district of Cumanà.

ERRATA ET CORRIGENDA.

Page 3, line 14, for " sugar" read " gum."
——— line 16, for " sugar" read " gum."
Page 6, line 42, for " weaken" read " weakening."
Page 31, Note, in the columns of weather, for " days" read " observations."
Page 40, Note, for " Long. 81 deg. 48′ W." read " 61 deg. 48′ W."
Page 43, line 26, for " young ones" read " young canes."
Page 45, line 16, for " this data" read " these data."
Page 48, line 14, Note, for " 46.5757" read " 45.5757."

H. H. Heydon, Printer, Tavistock-Street, Plymouth.

FIFTH EDITION.

AN ESSAY

ON THE

IMPROVEMENT TO BE MADE IN THE CULTIVATION

OF

SMALL FARMS

BY THE

INTRODUCTION OF GREEN CROPS, AND HOUSEFEEDING THE STOCK THEREON:

ORIGINALLY PUBLISHED IN AN ADDRESS TO THE SMALL FARMERS

ON THE ESTATES OF THE

EARL OF GOSFORD AND COLONEL CLOSE,

IN THE COUNTY OF ARMAGH.

WITH A PREFACE,

ADDRESSED TO LANDLORDS, GIVING FULL INFORMATION TO THOSE WHO MAY BE INCLINED TO ADOPT THE PLAN RECOMMENDED, AS TO THE BEST MODE OF INTRODUCING IT, AND THE RESULTS ATTENDING ITS INTRODUCTION, TOGETHER WITH THE EXPENSES LIKELY TO BE INCURRED THEREBY.

BY WILLIAM BLACKER, ESQ.

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PREFACE TO THE FIFTH EDITION.

HAVING formerly, in the Preface to the Fourth Edition of the following Essay, stated everything which then occurred to me as interesting to those landlords who might feel inclined to adopt the plan therein recommended, it merely now remains for me, in coming again before the public, to add such further particulars as my after experience may have enabled me to supply deserving their attention.

In this respect I now pursue the same plan as then adopted, viz. to communicate such information as may appear interesting to them, in the preface to that part of the impression designed for their use; so that what more particularly applies to the tenant may be given in a cheap form for his perusal, free from observations which might be considered foreign to his situation and circumstances.

In conformity with the foregoing, it appears necessary for me now particularly to notice the great amount of debt in which I found the poorer tenants involved, which has turned out to be vastly beyond anything I then supposed it possible for them to have incurred.

This, however, ceases to be any cause of astonishment when the nature of their transactions are detailed. For example, numerous cases have since become known to me where a poor man, from a miss-crop, loss of cattle, health, or any other cause, has been obliged to buy *on trust*, as they term it. He is then charged from thirty to forty per cent. more for the article he wants than the market price. When this payment becomes due it most commonly happens the debtor has no means of paying. To remedy this a new transaction takes place; and he is obliged to buy a cow, or a pig, or meal, potatoes, or anything the usurer has to dispose of, thirty or forty per cent. above the market price a second time; and this he sells for the most he can get, bringing back the produce of the sale to pay his first engagement. And so it goes on, the usurer getting his victim deeper and deeper in debt, whilst by occasional payments on account, labour-work, and often getting a portion of his land to crop, he has been himself paid twice over the real value of anything he had sold.* I will almost venture to say there is no poor man that has not suffered under this species of dealing; and very few who, having once embarked in it, are ever after able to extricate themselves, unless when some friendly assistance is given them.

This statement will be quite sufficient to show how tardily any symptoms of returning prosperity or comfort can be expected to appear; for these debts must be got rid of before the poor man can call anything his own, and every penny he earns is pounced upon the moment he receives it. Nor can I, with truth, say that this tardy appearance of comfort, *invariably* arises from the continued oppression of creditors. I have met many who, unaccustomed to have money in their possession, no sooner find they have a little at command, and their resources improved, than they commence to portion off their children, or brothers, or sisters, leaving *themselves* without a farthing, and even part with their stock for these purposes, with the most entire disregard of the ruinous consequences to which they must thereby become liable themselves. I am obliged, therefore, to confess that the progress to independence and comfort is considerably slower than I at first expected, subject as it always must be to be further retarded by the losses and casualities to which all farming operations are exposed. This last season I cannot estimate the loss arising to the tenantry on the Gosford estates in this county at less than a full year's rent, from the great extent they adventured in the cultivation of flax,* the low price of which has forced many to sell their stock from want of money, and many more from the want of fodder; and on a late examination, in the townland of Garvagh, several who, a couple of years back, had a full stock, are now found without any. However, I have no doubt they will shortly recover, owing to the great improvement in their mode of cultivation; it being rather a singular fact, that in this townland, consisting of one hundred and forty acres, there is not an acre of pasture, and a second crop of grain, only in two small fields, arising from peculiar circumstances; from which it is evident how much is now productive, though, a few years ago, it was, perhaps, the poorest and most exhausted townland in the entire county, having only three solvent tenants in it. The produce of the soil now is more than three times as much as it was then; and from the increase visible in like manner upon every farm where house-feeding has been adopted, conviction is by degrees forced upon the minds of the most ignorant and prejudiced; and, accordingly, year after year, I find old habits giving way, and a spirit of enterprise and taste for making improvements springing up, which fully satisfies me that the reign of prejudice is fast drawing to a close, and that the general introduction of improved agriculture may be confidently relied on wherever the system I have advocated is zealously persevered in. This opinion is confirmed by the manner in which it is gradually spreading in different parts of the kingdom; and even in Lord Gosford's Cavan estate, (where I have been unable, from different circumstances, hitherto, to give that personal attention which I should wish to pay,) the improvement, under the sole superintendence of the agriculturist, is favourably, though, perhaps, more slowly advancing, and I have no doubt whatever will in the end succeed.

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* From this may be seen the immense benefit which might arise from a loan fund, *well managed;* but unless the agent of the estate becomes the active person, I do not see almost how *this* can be calculated on. The agent can safely enough go security if the tenant holds at will, because he may turn him out if he fails or deceives him, but no one else can; and where security is required from others, I fear a heavy charge is made to the poor man for giving that security.

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* When preparing the last edition I had been led to suppose that the advance in the price of flax had arisen from so many spinning mills having been erected on this side of the channel, and I rather encouraged the expectation of its turning out hereafter a profitable crop; but immediately, on discovering that the advance had arisen from a failure of crops on the Continent, I saw that when the usual crops were again obtained *there* the price *here* must fall below the cost of production, and I did all in my power to prevent the growth, but in vain, and the prices have been ruinous, just as I expected.

I feel it, however, incumbent on me to warn the public now, as I have already done before, against indulging in those expectations of general and perfect improvement in the cultivation of the soil, or in the circumstances of the tenantry on the Gosford estates, which the individual cases brought under notice by the distribution of the premiums at the Markethill agricultural meetings may have excited. All that can be *fairly* said upon the subject is, that a decided improvement has commenced, and that, in emerging from a most inferior state of agriculture, there are many particular instances of superior cultivation observable, which would not do discredit to any country whatever; but to say that, in a general point of view, we can by any means compete with the improved appearance of many districts in Down and Antrim, which are fully a century before us in wealth and intelligence, is what neither ought to be expected, nor can be pretended to. It may likewise be satisfactory to state, that the favourable expectations held out, in last Edition, of the punctual repayment by the tenants of the advances made to them, have been fully realized. See page xii.

Having thus represented, as fairly as in my power, the existing state of things, I shall merely add that I have thought it unnecessary, in the present edition, to reprint the different letters and extracts which are introduced in the former appendix, as they appear to me no longer necessary in the present advanced state of agricultural information; and my readers will, I hope, consider the deficiency compensated for by the addition of much original matter on the various subjects discussed, and by the introduction of some of the most interesting speeches of the premium men, selected from the reports of the Markethill agricultural meetings, in which they give some account of the benefit they have derived from the system they have been latterly pursuing.

This explanation being given, I conclude by most respectfully soliciting from the public, for the present edition, a continuation of that patronage by which the former have been distinguished.

WILLIAM BLACKER.

PREFACE TO THE FOURTH EDITION.

It is now about three years since the Address of which the following is an improved edition, was printed, being merely intended for circulation among the tenants upon the estates of the Earl of Gosford, and Colonel Close, but the manuscript having been seen by one or two friends, the subject became talked of, and several landed proprietors having expressed a desire to obtain copies for distribution among their tenantry, the idea occurred of printing off an extensive second edition, and trying to gain something by the sale for charitable purposes. Accordingly, 2,000 additional copies were printed, which, in a few weeks, were all sold. This favourable reception by the public, together with a continued inquiry for further copies, would have sooner induced me to bring forward another edition, had I not considered it better to defer such a proceeding, until sufficient time had elapsed to prove whether the plan laid down might appear to be attended with such results as would be likely to recommend it for general adoption.—That such results have taken place, will, I think, be very apparent to all those who have been in any degree acquainted with the estates in which the experiment has been tried, upon even a very cursory inspection of the different farms. On examination, it will be seen, that the ruinous practice of successive corn crops has been, I may say, entirely superseded by the introduction of clover and grass seed, and vetches; and that turnips are become very generally in use for the winter feeding of stock, and, in many instances, to the extent of stall-feeding beef cattle, for the home or the Liverpool market; and the tenantry in general, upon both estates, will be found exerting themselves to the utmost, to increase their stock to the extent which they now perceive the crops mentioned will enable them to support, and a spirit of industry and activity is set on foot, that cannot but be attended with the very best effects. Even the passing observer will, I think, find his attention attracted by the rich appearance which the luxuriant clover crops give to the country, where the poorest pasture was formerly alone to be seen, and will be struck by the frequent recurrence of the small patches of turnips adjoining the cottages, so rarely to be met with elsewhere.

The great difficulty at present felt by the tenant is, in procuring cattle to consume the increased quantity of food which they now find themselves possessed of; for, notwithstanding every thing that could be said upon the subject, they could not be persuaded of the great additional stock which the same ground would enable them to maintain, under the system recommended, compared with what they were formerly able to keep; and this difficulty has been much increased by the unusual high price of cattle this last season, which has prevented the poorer class from being able to purchase. There are, nevertheless, many satisfactory instances of the increase of stock, half a dozen of which, in different quarters of the estates, I think it right to mention, in order to give the public that opportunity for investigation, which it is desirable should be afforded:—

Thomas Ingram* of Drumhoney, on the road from Markethill to Dundalk, about twenty-three English acres,† keeps two horses, nine cows, one heifer, two calves, and four pigs. He was always a good farmer, but by house-feeding, has been able to increase his stock, *last* year, two cows, and *this* year, three cows, one horse, and one heifer, and has as much crop as he formely had.

James Mulholland of Carrickgollogly, near Baleek, holds six English acres, upon which he has three cows, one calf, and one pig. Formerly he was only able to keep one cow.

Thomas Alexander, Corlust, near Clare, holds five English acres, which he lately purchased from a man who was only able to keep one cow: but by sowing green crops, he is now able to keep two cows, one heifer, two calves, and two pigs.

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* This man has received from Mr. Stewart of Ards near Derry, a very valuable farm of 60 acres, at a moderate rent, without any purchase money; with a view to his introducing an improved system of farming in that country.

† The English acres is that which is referred to throughout this work.

John Hogg, of Drumgaw, near Armagh, keeps now in the house four cows, one calf, and two pigs. Formerly he was only able to keep one cow.

Patrick Farrel, Garvagh, on the road from Markethill to Hamilton's-bawn, has now two cows, upon five English acres, and one pig. Formerly he had no cow at all.

Widow Brannigan, near Hamilton's-bawn, holds two and a half English acres; keeps, by means of house-feeding, one cow and one pig, and has oats, flax, and potatoes for herself and daughter. She had no cow formerly whatever.*

In alluding to the foregoing instances, I assume the increase of the stock kept to be a sufficient proof of the increase of the growth of green crops; and, in like manner, the increase of green crops to be a sufficient proof of *improved cultivation*, and, of course, *of the success of the plan recommended, which*, from the experience I have now had of it in several counties, I feel no hesitation in saying, may be successfully introduced into any part of Ireland.

Being encouraged, therefore, to think that the plan I was pursuing might be of public advantage, if more generally known, I lately prepared a third edition, in which were introduced such alterations and observations as experience suggested to be likely to increase the utility of the work, and this edition having been all engaged before it could be got from the bookbinder, I am induced now to bring forward a fourth, of a much larger number of copies, and considerably improved, by a better arrangement of the subject, and by the introduction of additional and important matter. The great interest which has been excited in the public mind by the report of a *successful* experiment having been made for bettering the condition of the small farmer, and the numberless applications I have received in consequence, for further information as to the best means to be pursued in carrying the plan into execution, and inquiring the cost that would be incurred thereby, with many other queries, induce me to think it will not be unacceptable to the public that I should give some account of the origin and progress of the plan I have pursued—in doing which, I hope I shall be excused for introducing such particulars as may appear likely to encourage and excite others to adopt that which I myself have experienced to be so advantageous, and so calculated to promote the interests of both landlord and tenant—interests which no friend to either can ever wish to see disunited, and upon the union of which being maintained must always so greatly depend the happiness and well-being of society.

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* This was a correct account of the stock when it was written, but changes in this respect are continually taking place. Farrell, I hear, has sold one cow, on account of his turnip crop not being productive this season, but will replace her when his clover is fit for cutting.

For several years I had been turning my attention to the improvement of the tenantry on the estates alluded to, and had made several unsuccessful attempts to introduce a better system of agriculture, by circulating the different works published on that subject, and offering premiums for those who would adopt the improvements recommended; but I had the mortification to find there were no claimants for the prizes proposed, and that every attempt I made was a complete failure. At length it occurred to me, that by writing a short address to the tenants, their attention might be drawn to the effects of the present system, and by following it up with the appointment of an agriculturist, for the special purpose of instructing them: and, moreover, by permitting him to grant a loan* of lime to such as followed his instructions, for the purpose of replacing the manure which he might require

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* When I first began to lend out lime, almost every person told me I should never get payment of it, but the result has justified my confidence in the tenantry, who are now bringing in the amount as it becomes due, without my having been obliged, in any one instance, to have recourse to any compulsory process.†

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† It may be satisfactory to state, that the favourable expectation here held out has been since realized: this last year I have received of payments from the different estates under my management, the large sum of £2423 9s. out of which the value of clover seed alone amounted to £913 9s. 8d. The plan I adopt, is to insist that all advances shall be settled before receiving the rent; and if there is not enough produced to pay both, I make it an invariable rule to have the former paid off, in the first place, and allow some little further time for making up the latter; and, when this becomes fully understood, there is no attempt made to evade it.

for the cultivation of green crops, and adding my own personal influence, I might, perhaps, have better success. Accordingly, an Address, of which, as I have said, the following is an improved edition, was printed and circulated, with an effect far exceeding my most sanguine expectations: and it appears to me this plan of bringing about the consideration of the matter, has greatly the advantage of a personal discussion. People do not like to see what they have considered to be right from their infancy—the propriety of which they never have had a thought of doubting—cried down as erroneous; nor do they like to find themselves worsted in the arguments they advance in the support of their opinions; so that a kind of obstinacy is awakened, sometimes, by a personal communication, which the silent attacks of a writer, in print, is not liable to create. Besides the circulation of a number of pamplets by the landlord, is sure to make their contents a matter of general conversation among the tenantry, which, in itself, is a great point gained—as in the discussion, even among themselves, some light is sure to be thrown upon the subject. I therefore decided upon giving a copy to every tenant, both as being the best mode of attaining my object, and also being by much the most economical method of bringing the subject fairly before them. If the agriculturist is to be detained explaining and arguing with every individual, he will be kept talking when he ought to be acting, and he will not get as much done in three years as he might have accomplished in one, had the minds of the tenantry been prepared for his instructions. Be that as it may, I found the address fully to answer the purpose intended, and it was generally admitted to contain what was beneficial and right, and that if it could only be carried into execution, a great advantage would certainly be gained.

The great fear of lessening their potato crop being removed by the loan of lime, which more than replaced all the manure that was demanded, and my own influence being exerted to the utmost, above three hundred small farmers in each estate were induced to make the trial the very first year, and the season proving favourable for the turnip crop, it was most abundant, and was completely established in the opinion of the country; and the extent since sown has been each season increasing, so that I expect in another year the quantity grown will be equal to the support of the proper stock which I calculate a farm in all cases requires—that is, one cow at least for every three acres of arable land. But the improvement in the agricultural system has not been confined to the growth of turnips. Mangel wurtzel, vetches, and clover, have been also introduced, and the tenants have been shown that the latter, which they very generally believed would not grow, had been heretofore only prevented by being sown on land exhausted by corn crops; and now, being found to thrive when sowed with first grain crop after their potatoes, it has, as I have stated, almost entirely banished the custom of taking two crops of grain in succession, which is a change of the most important nature.*

In order to assist the undertaking, both the Earl of Gosford and Colonel Close offered premiums for house-feeding the cattle. At the commencement, there were but two tenants on the estate of the former, and none on the latter, who were able to enter into the competition. The second year there were about fifty competitors. In the third, I should think, there could not have been less than three or four hundred, who fed their cattle either entirely or for the most part in the house; and this year, from the great quantity of cloverseed sown last spring, I think there will scarcely be a tenant on either estate who will not feed his stock upon that plan.†

I consider it quite unnecessary to say any thing in proof of the great advantage of having such a system introduced, and shall only add that, if the Agent is a person of good feeling, he will be amply repaid for the great personal attention he must first bestow in its introduction, by observing the growing prosperity of those placed under his care, by its operation. But this is not the only incitement. It is well known what difficulty and vexation attend the collection of rent from a poor tenantry; and what painful feelings the agent is often obliged to undergo in enforcing payment from many who are ill able to afford it, and, perhaps, being obliged to dispossess others, from their inability to pay any thing, and thus leaving whole families exposed, houseless and friendless, to want and misery. From all such harrowing sensations he will soon be relieved by the operation of the system I recommend. As an example, I might mention its effects in Lord Gosford's Cavan estate› consisting of about eight thousand acres. This estate being greatly in arrear, I had tried every means short of those violent measures above alluded to, in order to obtain punctual and regular payments, but without effect; and, notwithstanding the estate was moderately let, the arrear was rather increasing than diminishing. But the year before last being the second since commencing there the system I have described, the entire year's rent, and part of the arrear, were paid without difficulty; and this last year, the same thing has taken place, and the amount has been paid cheerfully, and with good will. And upon his Lordship's hereditary estates in the County of Armagh, a similar good effect has been produced.

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* In order to expedite this result, I adopted the plan of lending out clover and vetch-seed, upon a credit of six months, on condition that the former was sowed with FIRST grain crop on the manured land, and that the latter should be substituted in place of a SECOND grain crop, where the sowing of clover with the first crop had been neglected. This plan has been found very efficacious, and by opening an account with a London seedsman, I got the desired credit from him, so that I was nothing out of pocket. The value of this accommodation to the tenantry may be estimated by the amount lent out, as appears in note page 12.

† See a similar statement in the Appendix from Mr. Anderson, agriculturist on the Rich Hill estate.

The result on Colonel Close's estates has been equally gratifying, and on either estate the number in arrear is not greater than what the usual casualties of sickness and death of cattle, &c. will account for—so that I may say *there is no permanent arrear whatever*. Thus it appears, that in addition to *those* of a higher order, *personal motives* are not wanting to incline both landlord and agent to fairly try the plan proposed.

I am quite aware of the degree of incredulity which prevails in the public mind as to the practicability of introducing any beneficial change either in the habits or circumstances of the lower classes in this country: and this is the reason which has induced me in the foregoing pages to mention the names of some of those who were evidently bettering their condition under the system I have been acting on, in order that the public might feel assured of the truth of the facts stated. And with the same view I now mention the names of a few of those who were in the greatest arrear at the time referred to, and who now have paid up *every shilling* of what they owed; for I make it a standing rule *never to forgive any arrears whatever*, which would be bad encouragement to those who had regularly paid their rent as it became due.

It is true, that upon being appointed Agent to Lord Gosford, finding the war rents had been continued long after the fall in the prices of agricultural produce had made a reduction in rent necessary, I recommended to his Lordship to give the tenantry credit for the abatement they were entitled to from that cause; calculating it from the date when it ought to have been made, which of course would lessen the amount due; but I do not reckon this as *forgiving* any real arrear, as the same reduction, and calculated from the same time, was allowed to those tenants who were in no arrear, just the same as those who were—being merely an act of justice to which all were equally entitled.* The names of the tenants I was about to mention are, Edward Corr of Ballindarragh, two years in arrear; Mathew Watson, of Corromanen, three and a-half years; George Robb, of Baleek, three and a half years; John Clinton, of Argronsell, two years; Owen Trainor, of Drumhoney, two years. I might go on with the names of a number of others, but consider it unnecessary, who, as well as those mentioned, are every one now entirely clear, and their arrears paid up. And what makes the proof drawn from the reduction of the arrear more satisfactory is, that it is not occasioned by means of increased coercion or severity in the collection of rents, for the number of ejectment processes which it was formerly found necessary to serve, for the purpose of enforcing payment, have been every year decreasing, so that in the last year not a single ejectment process has been served on either estate. As to selling any distress, it was never at any time resorted to.

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* I shall never forget a scene which took place upon one occasion, when the extent of the reduction to be made was under consideration; and his Lordship went with me himself personally to examine into the state of things, the surveyor accompanying us; and being upon a farm held at will, near Baleek, which had been greatly improved, and was not in any arrear whatever. The owner, the late Bernard O'Hear, came up to us, under evident alarm and agitation, fully impressed with the belief that the consultation he saw going on could be for no other purpose than to decide upon what advance he should be charged, and began in the most desponding manner to represent all he had done to improve the ground, and pointed out the adjoining fields remaining in the same unreclaimed state from which he had rescued his portion, concluding by throwing himself entirely upon his Lordship's generosity; and was about to retire, when his Lordship called him, and said, he had entirely mistaken the object of his visit, which was to *reduce* his rent, and not to *raise* it; and that the reduction should be allowed for the two years preceding; for which he gave orders on the spot, adding, that he saw the improvements he had made, which he hoped he would long live to enjoy; and cordially shaking him by the hand, proceeded to another farm, leaving *him* overpowered with feelings of gratitude and surprise, which he was wholly unable to express, and the *byestanders* at a loss to decide whether the feelings of the landlord or the tenant were most to be envied.

In laying before the public the flattering results which have been stated, I should wish to guard against raising unreasonable expectations. Miracles have long ceased, and it is not to be expected that all at once, nor even in the course of three years.* any system, however good, will create about the habitations of the small famers, in all cases, that look of neatness, content, and comfort, which easy circumstances generally produce. It is very up-hill work for a man, perhaps in heavy arrears, or what is still worse, in debt to his neighbours, to pay all off, and arrive at ease and comfort, having his rent to pay and his family to support, and his only means the possession of a few acres of exhausted land. The first symptom of improvement will be the paying off his debts and arrears of rent; and if he can in the first three or four years free himself from these, I think as much has been accomplished as can well be expected. But it is in vain to look in so short a time for that change in the general appearance of any estate, which will decidedly mark the existence of comfort and independence, which has not, nor cannot be supposed possible to be acquired in the time. I have stated, however, that even a cursory *examination* of the farms will show an evident improvement, and that the passing observer will be struck with the rich appearance of the clover crops, &c.; but as long as the small fields and crooked fences remain, the finest crops in the world will scarcely be sufficient to give such a decidedly improved appearance to any estate as to show a *very marked difference* between it and the adjoining lands: therefore, those who from reading the declarations of those tenants on the Gosford estates, who by their superior exertions have gained the premiums offered by his lordship, and who may expect every thing in and about the estate in perfect keeping therewith, I am forced to confess, will find themselves most egregiously deceived in their expectations. But upon *examination*, I think they will find quite sufficient to satisfy every reasonable person, that the system acting upon is most successfully advancing, and must ultimately, and in the course of a no very distant period, produce a most remarkable alteration, fully sufficient to justify the anticipations in which Lord Gosford was led to indulge, from witnessing the proofs which the Markethill Agricultural Dinner brought before him.*

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* It is only a small proportion of the tenantry who have been three years acting under the system, and of those the greater part began upon a very small scale; the rest of the tenantry have only been induced to begin in succession, from seeing the success of others, so that an entire change in the face of the country is manifestly not as yet to be expected.

But what, it will be asked, may be the expense of attempting to follow a plan, which it must be admitted *seems* at least to have much to recommend it? To this it may be answered, the expense is trifling indeed, compared with the objects likely to be attained. Those agriculturists I have hitherto brought over, and who have all turned out to be very deserving men, have been engaged at a salary of twenty-five pounds a year, with a cabin and two acres of land rent free, or in *lieu* thereof, a lodging, with the Scotch allowance of six and half bolls of meal,* and what milk they might require, all which does not amount to more than about ten pounds a year in addition to their fixed salary. Nothing can be accomplished on a large scale, without having a respectable man in this situation, for the ignorance of the generality of small farmers is such, that they will often put out their lime on land not drained, whereby the advantage of it will be lost entirely, and they will sow the clover seed on *exhausted* land, where it will not grow, and will therefore become a total loss; also they have, generally speaking, little idea of what *clean* land is, nor how to set about making it so, and their manure therefore goes to nourish weeds as much, or more perhaps, than the crop sown; for all which reasons I look upon this appointment as indispensable where any extensive success is aimed at. The next expense to be considered is the advance of lime. In this respect my practice has been to lend it almost to every one who applied, let their circumstances be what they might, making only the stipulation that the instructions given should be strictly followed. I adopted this line, in order to show the people that my wish was to benefit every one, and that I was not actuated by the selfish motive, of merely assisting the very poor class, in order to lessen my own trouble in getting their rents. The liberality of my employers enabled me to act on this extended plan, which of course occasioned the greater outlay. But when the landlord is restricted in means, of course the loan will be confined to those who stand most in need of the assistance. The advance required depends so much upon the size of the farms, the density of the population, and other circumstances, that it is hard to fix on any sum per thousand acres, as sufficient for this branch of the expenditure. The more people there are, the more industry is capable of being brought into activity, and the more capital is of course required; likewise, the greater the poverty, the greater assistance will be necessary; so that the advance required must evidently vary in different estates, though they may consist of the same number of acres. But I would hazard the opinion, that in most parts of the North of Ireland, fifty pounds per thousand acres would be found sufficient to supply the requisite loan of lime, and provide turnip and rape seed, which I have as yet given gratis.* Every poor tenantry, will be found so much in debt for their seed oats, seed potatoes, and perhaps even for subsistence, and subjected thereby to such usurous charges, that I have found it necessary to give in the first instance three years' credit, in order to get them out of the power of their creditors. The repayment of the sum so lent, now forms a fund for carrying on the system, and I do not anticipate being obliged to make further demands upon my employers; but when this credit, from the pecuniary wants of the landlord, cannot be given, I think the repayment might be insisted on from the produce of the first grain crop after the loan. My lending of clover seed was an afterthought, but is a matter of primary importance; and the cost of the supply came to so large a sum, that I was obliged to limit the credit upon it to six months, which brought the repayment to the time of harvest: and as I obtained the same credit from the London seedsman that I gave to the tenantry, there was no advance of money in that particular, and the advantage has been the greatest that could be imagined, in immediately doing away with the practice of sowing successive grain crops, as already alluded to.

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* His Lordship then said, "that in consequence of the increased cultiva-"tion of the land, there would be an increased employment, and consequent "additional comfort to the agricultural labourer, while the increased profit to the "farmer, which the statements they had heard fully supported him in count-"ing upon, would give them a property, which they were not at present, he "was sorry to say, generally possessed of. That the sure consequence of this "would be a growing respect for those laws by which property was protected, "and a feeling that the said laws *were made for their advantage and protection*, "in place of being considered (which was now too generally the case) as hav-"ing been framed for their *coercion*."

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* The Scotch boll weighs 140lbs.

To sum up the whole then, it would appear, that to make the conviction produced by the perusal of the pamphlet *operative*, all required on the *part of the landlord* would be, an annual outlay of about thirty-five pounds to the agriculturist, which would afford the necessary instruction, and an advance of about fifty pounds a year per one thousand acres, for three years at most,† in lime, to replace the manure taken from the potato crop. This is the entire expense, except the trifling cost of the pamphlets; and when to this the tenant has added his industry, and the agent contributed his influence, the system is complete. I do not in the above calculation, include the trifling sum which the landlord may feel disposed to give in premiums, for the encouragement of those who most distinguish themselves by their exertions, nor any occasional assistance he may feel disposed to give in lending a pound or two, for a few months to assist a tenant in buying an additional cow, when his clover was superabundant—these being optional matters, and not absolutely necessary.

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* The actual advance necessary to be made in money, may in many cases be much lessened by good management; for instance, where a tenant who has a horse is in arrear, he may be employed to draw lime or limestone to those who are without one. The man who gets the loan of lime, will always be made thereby a good mark for the cost, so that both tenants are relieved, the one by getting employment, and the other by getting the lime, and the landlord gets the arrear well secured at the same time that it is converted into capital employed in improving his estate.

† For reasons given in Preface to Fifth Edition, I continue this loan to all who require it.

Having entered so much into detail as to the advances required on the part of the landlord, it may not appear irrelevant to advert to the *industry* required from the tenant, which is still more indispensably requisite to the success of the plan, than any thing which has been stated; for *with this* the poorest tenant may, generally speaking, get on in the world unaided by his landlord; but *without it*, all the assistance that can be given him will be thrown away; for no man who is not industrious can ever succeed as a small farmer: and such is the reputed indolence of the Irish character, that some may suppose the whole will fail through this single deficiency. But in the plan proposed, such strong inducements are given to stimulate the tenant to exertion, that I think very few will any where be found wanting in that respect. The incitement to industry arising from a loan of lime not being apparent to those who have not considered the subject, it may not be amiss to state, that in this neighbourhood, twenty shillings will buy at the kiln twenty-six or twenty-seven barrels of lime, which is quite sufficient to manure one English acre for a crop of potatoes of the kind called cups. After this the said acre will yield a crop of wheat, or other grain suited to the soil, to which will succeed the crop of clover that has been sown with it, and after the clover another grain crop; these four crops are upon an average worth five pounds each, that is *twenty pounds* in the whole, which the farmer makes by his industry out of the *twenty shillings* worth of lime lent him, and all upon one acre only of his farm, which acre most probably would have been, perhaps for the *entire* time, lying out to rest, as it is called, nominally in useless pasture, but *really* producing nothing. But the plan is not confined to the reclaiming of *one* acre, nor is the occupier to stand idle whilst these crops are coming round in succession. The loan of lime is still continued, and another and another acre is brought into cultivation, opening to the view a continually increasing return, until the whole farm is finally brought into its most productive state.

Now, this is the incitement which I have found, and which I think will always be found to answer the end proposed. I maintain there is no unwillingness in an Irishman to work where sufficient remuneration is held out—but he will not work for nothing, and he would be a great fool if he did. In proof of my assertion, let me refer to the Irish labourer when employed at good wages in London. Look at him also when employed at home upon a good piece of task work, and see whether any man living can work harder. Now the inducement held out in the present case is of that nature that every small farmer is fully capable of comprehending, and their great anxiety to get the lime shows plainly that they do comprehend it, and value it as they ought; and generally speaking, I have no reason to complain of want of industry; on the contrary, I have often had to remark almost incredible instances of successful exertion. There will, no doubt, be in all estates particular instances of remissness in *some* of the tenants, and several may perhaps be found, particularly at first, hard to convince of the importance of cleaning their land of weeds, draining and levelling their useless ditches, and other matters of a like nature, but by degrees they will all become sensible of the advantage to be derived by attention to these points—and I have seen nothing whatever to shake me in the firm belief, that the system I have explained is of a thoroughly practical nature, and must finally succeed wherever it is tried. Where lime is to be had, the benefit of the plan will be more immediately seen and felt, but in all cases there must be advantage derived, and a skilful agriculturist will every where find some means sooner or later, to get the tenant into a stock of manure, which is the foundation of all success in farming operations, and is always held up as such in the following address.*

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* When there is access to the sea-shore there is almost always sea-weed, or shell-sand to be had; when this resource fails, clay ashes may be obtained without

I do not think any unprejudiced person can deny that great weight is due to the considerations which have been laid before the reader; but there is still one fact which strongly bears upon the case, and to which I have not yet adverted, and that is the extraordinary change of character which the first ray of hope produces in the mind of a man sunk in despondency; and who having fallen into poverty and distress, has lost heart, from seeing no chance of extricating himself from his unfortunate situation. A man awakened from this state of torpor and depression of mind becomes a new creature when the prospect of comfort and independence begins to appear within his reach; and the exertion consequent upon the introduction of the first gleam of hope, is almost beyond the belief of those who have not had the opportunity of witnessing it. I have gone myself to see a poor man, the tenant of less than four acres of land, (whose name and residence I can give if required) who was threatened with an ejectment, being, as well as I recollect, two and a half years in arrear. I found him sitting with his feet in the ashes of a half extinguished fire, his wife and five children nearly naked; want and misery surrounding him on every side—his house and farm neglected—the fear of expulsion preying upon his mind and spirits having destroyed his health, and there he was awaiting the beggary and starvation impending over himself and family, in a kind of listless insensibility. In short, the whole scene was one of actual despair, and the man was evidently in such a state that he was incapable of any exertion whatever. Having satisfied myself that he was not wilfully slothful, I told him he should not be turned out, if he would take courage and exert himself, and that he should be assisted with lime, if he would follow the instructions given him by the agriculturist. As I explained to him the plan I had in view for his benefit, it was easy to see the feelings by which he

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injury to the land, wherever there is bog to be had to kindle a sufficiently large fire, which being once accomplished, the clay, just as it is taken out of the face of a hill, will burn. All these resources failing, still many others will present themselves, such as bone dust, rape cake, &c., by which excellent crops of *turnips* may be procured, and when *this means* of house-feeding has once been secured, the accumulation of manure to any extent is so much within the compass of every farmer's power, that it is entirely his own fault if ever he should again feel the want of that necessary article.

was agitated: with tears in his eyes, he promised to do every thing I required, and I left him, to send the agriculturist to point out what was first to be set about. He faithfully made good his engagement, and did every thing as he was directed, and when his turnips were ripe, I lent him, out of the sum placed at my disposal for that purpose, some money to buy a cow—the family had previously lived on potatoes and salt, and for even this he was in debt. This was his commencement, and in the short space of about eighteen months afterwards, I found his house clean and comfortable looking, and the place about it equally so; in fact, I could not put my foot upon a spot that was not either in crop, or in preparation for one, and he himself with his health restored, actively employed in wheeling up earth in a wheelbarrow, from the bottom to the top of a hill in his land, where the soil was shallow, in which his daughter, a fine stout little girl, was helping him, pulling by a rope in front, and the whole was a picture of activity, and successful exertion. These two years past have not been favourable for the farmer, but he has coutrived to pay up all his arrears, and although his diet and that of his family, is, of necessity, at present confined almost exclusively to potatoes and milk, they are all healthy, happy and contented. Another year I expect will enable him to pay off his debts, and then between the produce of his loom, and the increased produce of his farm, he will be able to command almost all the comforts which people in his line of life are so ambitious of. His rent is £4 8s. 3d. which the butter from his cow will generally pay, leaving him his pig and his crop, and the produce of his loom to himself. And yet this is the same man who, upon the same piece of land, and subject to the same rent, was so lately upon the verge of beggary and starvation.

I have already endeavoured to *guard* the *public* from indulging in unreasonable expectations, from the accounts which have found their way into the papers and periodical publications of the day; and I think it may likewise not be unnecessary to *guard* the *agent* against expecting too much also, and to warn him, that by thus coming into contact with ignorant and prejudiced people, much may occur to try his temper and exercise his patience; but the difficulties he may expect to meet with are almost always to be surmounted by calmness and perseverance, and are for the most part but a temporary annoyance; whereas the success of his endeavours will be a source of lasting gratification. In my own case, I must say, I have derived inexpressible pleasure from seeing many deserving people restored, through my instrumentality, to a prospect of comfort and independence, who had been reduced from various causes to great poverty and wretchedness, and seemed so far depressed by their situation as to have neither health or hope left to animate them to further exertion. And if such feelings belong to the *agent*, what must be the enjoyment of the *landlord*, who resolves to look into the situation of his tenantry, and by this means to lend a helping hand to their relief. The practice of seeing and relieving distress, not by unproductive almsgiving, but by affording the means and encouraging the spirit of industry among those whom sickness or misfortune may have depressed and impoverished, would soon create in the landlord that interest in the welfare of his tenants, which acts of kindness and benevolence are always sure to excite in the breast of the *benefactor* towards the *benefitted:* and whoever thinks that an Irish tenantry (once convinced of the friendly disposition of their landlord) would not repay such proofs of his regard with the most sincere and ardent attachment, knows little of their nature. Ties of affection would thus, ere long, draw together again those classes in society which at present seem too far removed, if not actually opposed to each other, and content and harmony spread around, would lend new charms to a country residence. The *sports of the field*, and *the pleasures of the chase* would no longer be the *only* attractions to allure the man of fortune to visit his estates—though even his enjoyment of these would be heightened by such an improved state of things.

The hired keeper is but a poor substitute in the preservation of his game, for the watchful guardianship of an affectionate tenantry, and the kind reception and cordial welcome he would receive from his tenants, in coming upon their farms, would give an additional zest to the pleasures of the day.

But when *those enjoyments of health* give place, as sooner or later they must, to the bed of sickness, and the aching head is laid on the pillow of reflection, then it is that the true value of every thing will be established, and then it will be proved, how grateful to the recollection those pursuits will be felt, which have the good of others for their object, and how poor and how pleasureless all those personal gratifications and amusements will appear, which now seem so much to occupy the attention and engross the time of landed proprietors.

From the many instances of wretchedness which so often meet the eye upon Irish estates, the name of an *Irish Landlord* is almost become a term of reproach, occasioned by a growing belief, that his heartless repacity is the cause of such misery existing, whilst the perhaps involuntary absentee fares still worse, and is held up to public indignation, without almost a single voice being raised in his behalf.

I am not one of those disposed to join in the general outcry raised against either of these classes, many of both, I am fully persuaded, need not be afraid to stand in comparison with the best specimens of the landlord, which Great Britain or any other country can produce. Numbers there are of each, I have no doubt, who with the best possible inclinations have heretofore shrunk from making any attempt to better the situation of those under them, from a firm conviction of the utter hopelessness of the undertaking. All such, I trust, will peruse with satisfaction the following Address, forming as it does, the ground work of a plan for carrying such benevolent intentions into execution—a plan which has not only been proved to be successful in practice, but which may be carried into effect without involving them in any permanent outlay, or even putting them to any extravagant expense; and, moreover, may be given up in a moment, if unattended with success, or no longer considered necessary, and calculated (as it has been clearly shown,) both to promote their own particular interests, and also to provide for the independence and improvement of their tenantry.

That many may be encouraged to make the attempt, and that their attempts may be attended with all the success they could desire, is the sincere and ardent wish of the writer.

WILLIAM BLACKER.

March 1834.

ADDRESS.

CHAPTER I.

INTRODUCTORY ARGUMENT—INCREASE OF STOCK BY HOUSE-FEEDING—INCREASE OF MANURE—CALCULATIONS IN REGARD TO EACH—CHEAPER TO FEED MILCH COWS ON RAPE OR TURNIPS, ALLOWING THEM TO BE WORTH TEN POUNDS PER ACRE, THAN TO FEED ON DRY FOOD, AND GET IT FOR NOTHING—GREAT ADVANTAGE IN REGARD TO COTTERS—BENEFIT ATTENDING THE PROPER ROTATION OF CROPS—NECESSITY FOR APPOINTMENT OF AN AGRICULTURIST.

INTRODUCTORY ARGUMENT.

You are all well aware of the disposition which at present very generally exists on the part of landlords, to diminish the number of tenants on their estates, and to increase the size of their farms. It is not here necessary to inquire into the reasons which influence them in this desire: it is sufficient for my present purpose to say, that, if such a plan were extensively acted upon, the result must be the total ruin of all the small holders and cotters, who, in many cases, are as industrious and deserving as any other members of society.

I consider myself most fortunate that I am not obliged to act, at present, upon the system above alluded to, and that my employers, however they may feel resolved not to continue on their estates persons of careless and indolent habits, are nevevertheless determined to assist and encourage all those of an opposite character; and impressed with this kind feeling, are anxious I should make trial whether anything can be done to reclaim the one and to stimulate the other, and if possible, to put both upon some better plan of supporting themselves and their families, than they at present appear to be acquainted with.

The only way in my mind to accomplish this is, by introducing such a system of agriculture as would bring the entire of the small farmers' holdings into a productive state, in place of allowing nearly half their farms to remain nominally in *grazing*, but in reality producing *nothing;* and, as this cannot be done without manure, and manure cannot be had without stock, the consideration naturally arises how can the *greatest* quantity of stock be most economically maintained, and under what management can the largest quantity of manure be derived therefrom.

Now, by referring to the experience of all good farmers in all countries, and under all circumstances, it is ascertained beyond dispute, that by the practice of sowing green crops, such as clover and rye grass, winter and spring vetches, turnips, mangel wurtzel, &c., the same ground which in poor pasture would scarcely feed *one cow* in *summer*, would under the crops mentioned, feed three, or perhaps four the whole year round—by keeping the cattle in the house, and bringing the food there to them;* and the manure produced by *one* of these cows so fed, and well bedded with the *straw* saved by the supply of *better food*, would be more than equal to that produced by *three* cows *pastured* in *summer* and fed in *winter* upon dry straw or hay, and *badly littered.*

Here then are two assertions well worthy your serious attention —first, that *three* cows may be provided with food in the house *all the year* from the same quantity of ground which will scarcely feed *one* under *pasture* for the *summer ;* and secondly, that *one* cow so fed in the house will give as much as *three* fed in the field. I call these important assertions, for if they are really founded in fact, then any of you who may now be only able to keep *one* cow, would by changing his plan be able to keep *three*, and each *one* of these producing as much manure as *three* fed in the way you have hitherto been accustomed to adopt—the result must be, that you would have nine times as much manure by the new method as you have hitherto had by the old. Now, as I don't think there can be a single individual among you so blind as not to see at once the great advantage it would be to have such an immense addition to his manure heap, it appears to me that the best thing I can do is, in the first instance, to endeavour to impress firmly upon your minds the conviction that this fact, *so much entitled to your attention*, and yet so *little attended to*, is in reality a truth that may be relied on, and may be practically adopted without any fear of disappointment. It is upon this foundation that the practicability of almost every improvement I mean to suggest in the cropping of your land must ultimately depend, and it is therefore indispensable to the success of any arguments I may offer, to place it before you in the clearest point of view, and remove from your minds every doubt whatever upon the subject.

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* The advantage of cutting the clover and bringing it to the cow, has been strongly exemplified this year, in the case of M'Parlane and Feenan, of Drumheney. They held a divided farm, and had exactly the same crop of clover, both in quantity and quality. M'Parlane cut his and fed *two* cows plentifully in the house. Feenan *grazed* his—and it proved a short allowance for *one.* And the succeeding crop after the clover is always much cleaner and better when it has been cut than when it has been pastured, though many farmers think otherwise.

To draw the necessary proof therefore from what comes under *your own* observation, I may say every day of your lives, and which must therefore have more weight with you than any thing else I could say, I refer you with confidence to the exhausted miserable pasture upon which your cattle are now almost universally fed, *two* to *three* acres of which are often barely sufficient to keep *one cow alive* for the *summer months, but by no means to afford her a sufficiency of food.* Now, one acre of good clover and rye-grass, one rood of vetches and three roods of turnips, (making up in all two acres, which are now allotted for grazing one cow in summer), taking a stolen crop of rape after the vetches, will afford ample provision for three cows the *year* round. For you all know that an acre of good clover will house-feed three cows from the middle of May to the middle of October; and with the help of a rood of vetches you will be able to save half the first cutting for hay to use during the winter. Then when the first frosts, about the middle of October, may have stripped the clover of its leaves, the early sown rape, which ought to be put in ridge by ridge as the vetches are cut, and the land well manured, (if the seed has been sown by the middle of July,)* will be ready to cut and feed the cattle until the turnips are ripe. Here then you have plainly provision secured until towards the middle of November; and we have to calculate what remains to feed the cattle until the middle of the May following. For this purpose there is a rood of turnips for each cow. Now, an acre of the white Globe and yellow Aberdeen turnip ought to produce from thirty-five to forty tons per acre; but supposing one-half to be of the Swedish kind, let us calculate only on twenty-eight tons to the acre, which is not more than an average produce, even if they were all Swedish, and see what that calculation will yield per day for one hundred and ninety days, which is rather more than the six months. If an acre yields twenty-eight tons, a rood will yield seven tons, which being brought into pounds will amount to fifteen thousand six hundred and eighty pounds; and this divided by one hundred and ninety days, will leave eighty-three pounds of turnips for each cow, every day, which with a small portion of the hay and straw you are possessed of, is a very sufficient allowance for a common sized milch cow; and over and above all this, you have the second growth of the rood of rape coming forward in March and April, which would feed all the three cows much longer than would be necessary to meet the coming clover crop, even in the latest season.

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* If the vetches are too late to allow the sowing of the rape to commence at that time, it ought to be raised in a seed bed, and transplanted, which may be continued with advantage to the end of August, putting the plants in as

Here then the facts of the case are brought before you for your own decision, and I fearlessly appeal to yourselves—is it true that two to three acres (I make my calculation on two only) are fre-

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thick as possible. Mr. William Scott, a tenant of the Earl of Charlemont's, who has been induced to try rape, from reading the first edition of this Address, asserts, that he has obtained from one square perch of transplanted rape, the amazing return of thirty-one stone five pounds, which would be nearly at the rate of thirty-two tons the English acre, and he would have two cuttings afterwards in March and May, supposing which to be only half as good as the first, there would be the enormous produce of sixty-four tons per acre—which seems so astonishing, that I questioned him particularly as to the fact, which he positively asserted to be the case, and that the ground measured was not superior to the rest of the field. If the rape, however, is too late, and therefore unfit to cut in October with advantage, the globe turnip will then be fully ripe, if planted in proper time, and the rood of turnips would hold out to the middle of April, from which time the rape would yield ample food until the clover came in.

quently allotted to graze one cow during *summer?* And again—is it true that an acre of clover and grass seed, a rood of vetches, and three roods of turnips, with the stolen crop of rape after the vetches, will fully supply food for three cows *the year round?* I defy any one of you to reply to either of these questions in the negative. The straw of the farm, in any case, belongs to the cattle; but in the latter case, where turnips are provided for food, it is chiefly used for bedding, and the additional quantity of grain which will be raised by means of the increased quantity of manured land, will always keep pace with the increase of the stock, and provide the increased quantity of bedding required. I think, therefore, I am warranted in considering my first assertion proved; namely, that the ground generally allotted to feed *one* cow, will in reality supply food for *three*—and have now only to offer some calculations as to the accumulation of manure, which I hope will be considered equally conclusive.

During the summer months, your cow which is only in the house at milking time, (and perhaps not even then, for the practice is sometimes to milk her in the field,) can afford little or no addition to the manure heap, being upon the grass both day and night; and even in winter and spring, whilst there is any open weather, they are always to be seen ranging over the fields in search of food, so that I think you cannot but admit (upon a calculation for the entire year round,) the animal is not in the house more than eight hours out of the twenty-four, and it is only the manure made during this period which can be reckoned upon; therefore upon this supposition, (which I think is sufficiently correct to show the strength of my argument), if there is any truth in arithmetic, *one* cow fed as I calculated on, in the house for the entire *twenty-four* hours, will yield as much manure as *three* cows that are only kept in the house for *eight* hours—the quality of the food being supposed the same in both cases; and this would manifestly prove my assertion; namely, that *one* cow fed *within*, would give as much manure as *three* fed *without*: and therefore when *three* can be kept in the one way, as I have already shown, for *one* kept in the *other*, *it is as clear* as three times three make nine, that the result of the calculation will be just as I have stated—namely, that the farmer will obtain by the change of system nine times as much manure in the one case as he would have had in the other.

Now, if after all that has been said, (which seems to me at least quite convincing,) any of you should be so astonished by the quantity of the manure thus proved to be gained as still to have some misgivings on the subject, and be inclined to think that matters would not turn out so favourable in *practice* as I have shown in *theory*, I would wish any such person to consider one very material point which I have not yet touched upon—for in the foregoing, the argument is founded entirely on *the time* the animals are kept within, viz.—it is stated that *one* cow kept within for *twenty-four* hours will give as much manure as *three* cows which are only kept in for *eight* hours, the food being assumed to be the same in both cases; but it is quite evident that if the cow kept within should be fed with turnips and *bedded with the straw* which the others are *fed* upon, leaving them *little or no bedding whatever*, that the calculation must turn decidedly in favour of the animal which *is* well fed and bedded, both as regards the quantity and quality of the manure—so that it appears the estimate I have made is decidedly under the mark.

I may here be challenged to name any one who has really accumulated nine times as much manure in the manner I have stated to be practicable. My answer to this would be, that no one individual has thought it necessary to apply all the land formerly allotted to grazing his stock, to the *purpose* of raising *green crops*, to feed them on in the house. As fast as the manure heap has enabled them to do so, those who have adopted the house-feeding system, have been anxious to bring their useless grazing into *potatoes*, and *wheat* or *other grain*—enough of the old prejudice still remaining to make them think they were serving themselves by so doing;* and *they have not given* the ground saved to the raising of turnips, mangel wurzel, &c. and of course have not kept cattle to consume them—but I fearlessly refer any doubtful enquirer on the subject, to go to the houses of those men who have gained the premiums offered by the Earl of Gosford and Colonel Close, for the encouragement of house-feeding—Moses Greer of Corlust—Ingram of Drumhoney—John Hogg of Drumgaw, or James Bradford of Druminnis, or any of the others most convenient to him, and let him examine *their manure heaps*, and examine *themselves* as I have no doubt *they* have been upon many occasions, and then let him judge for himself, whether there is any reason to doubt the truth of what I have stated. But the case does not require that I should rigidly adhere to the strict letter of the argument. I need only ask you to think *what you might do* in your farms, if you had but six, five, or even four times as much manure as you now have; or rather let me ask *what is it you might not do* if you had such a supply; surely you would not in such a case let the land lie waste, as you now do, to recover itself, when you had the means of instant recovery in your own hands; nor would you rely upon *one* half of your farm to pay the rent of the whole, when you had the means within yourself of making the *other* half equally productive.

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* I am well satisfied in my own mind, that cattle crops will pay more at present in milk and butter than any other crops whatever, except flax or wheat: and if the farmers' wives could be prevailed on to put less salt in their butter intended for the English Market, the price would be greatly improved, and the Dutch butter would be driven out of the market. Should a farmer be induced to increase his stock, so as to make a firkin or half a firkin once a

Having therefore, I think, set this matter at rest, I now proceed to state what perhaps may add much more to your surprise, namely, that many people well informed in these matters assert, the allowance of two acres of land which I have made, is by no means required for the support of *three cows the year round*, and that *much less* would do: and I confess that in making the calculation I have just laid before you, I have been allowing much more than I believe to be *absolutely* necessary—for this simple reason, that without going into the minutiæ of what may be the very most that can be done upon a small piece of land, the advantage to be obtained

fortnight, the conveyance by steam is so rapid and so certain, that the butter might be safely exported to Liverpool or London, nearly fresh, and those Merchants engaged in the trade would do a public service, by bespeaking from the farmers of their acquaintance, butter to be made up in this manner, and to export it under a different brand, which would soon bring the matter to proof. See Appendix upon this subject.

merely according to the statement I have given is quite great enough to attract your attention, and put you, (if any thing can) upon making some alteration in your present system: and the truth both in theory and practice of what I have pointed out is so obvious, that all possibility of contradiction, or evasion, is completely set aside, which I consider a matter of no small importance. The allotment I have made of two acres for the support of three cows, is the same as allowing two-thirds of an acre for each cow, which I have no doubt you will think is a moderate allowance, but to show you the opinion of very sensible writers have who made this subject their study, I beg to mention that Mr. Allan in his little work, entitled, "Colonies at Home," estimates the ground necessary to supply food for a cow the year round, at only *half an acre*, and Mr. Cobbett, in his work entitled, "Cottage Economy" says, that *one rood* of ground will be found amply sufficient. For the particular plans pointed out by these writers, I must refer to their own writings, but will venture to remark, that, to the instructions given by Mr. Cobbett may be added a recommendation to have the cow carefully curried, which is necessary to the animal's health when kept in a state of confinement, and will materially increase the quantity of milk;* and her food might be given to her in a small straw yard for a portion of the day, for the sake of exercise; or she might be put out upon a tether to graze for an hour or two, in good weather, if the farm afforded a suitable place. And I would also strongly recommend particular care to be taken in transplanting the turnip plants—to raise them without breaking the smallest fibre of the root, by putting the spade completely under them, so as to loosen the earth about them, and in putting them into the ground, to take the same care that the roots are placed in the natural position, and not doubled in. Without attention to these points, the crop will be injured; indeed, it is so seldom that transplanted turnips produce *in this country*, the crop Mr. Cobbett calculates upon, that I should prefer your applying half an acre, or even two thirds of an acre, to the support of your cow, in order to enable you to sow your turnips in the usual way; or instead of them, mangel wurzel, where the ground is suitable; and if half an acre, or two-thirds of an acre, with the addition of a trifling quantity of straw, will insure an ample supply of food for a cow during the entire year, I think none of you will consider the ground misapplied. It is so hard, however, to get persons unaccustomed to be directed by printed instructions, either fully to understand them, or if they do, to put them in practise, that although I allude to the directions given by these writers, for the instruction of all who may chuse to adopt them, and particularly for the benefit of cotters who may only have a house and garden; my own opinion is, that the simple plan I have laid down, which every small farmer can easily comprehend, and can as easily carry into practice, without interfering in the least with the general cultivation of his farm, is the best system to recommend to you for adoption, and I think it is quite evident from what has been said on the subject, that if you take advantage of the kail and cabbage* which you may raise in your gardens and potato ridges, as will hereafter be pointed out, together with the additional stolen crops which may be raised in the rest of your farms, of rape, stubble turnips, or annual clover, after the crops of grain, or on the early potato and vetch ground, as pointed out under the head of rotation of crops, that the quantity of land *specially* applied to the feeding of your cattle, may be reduced to the half acre, which is the quantity Mr. Allen calculates upon. It appears to me, therefore, quite undeniable, that the foregoing can be carried into practice, and if so, and upon a plan which requires no particular trouble or skill in the management, how shameful is it for you often to let two, or perhaps three acres of land be wasted as I have stated, to graze one animal in summer, and to have her starving all the winter, upon bad hay or fusty straw. The importance of house feeding your cattle seems to me so great, and I have therefore said so much in regard of it, you may perhaps suppose the subject exhausted, and that nothing more can remain to be added; but I have still something to mention, which may perhaps appear to you more surprising than any thing you have yet heard: namely, that you will have more profit by your cows if you feed them on green food, *and pay a fair price per acre for it*, than if you fed them upon the hay and straw you generally give them, *and got the said hay and straw for nothing*. This I have no doubt will appear a very strange assertion, but it is not at all more strange than true, and to prove it I refer to the case of James O'Neill of Garvagh—This man was a complete pauper when Lord GOSFORD bought the Graham Estate; but, by the assistance and instructions afforded to him, had got his small portion of land into a good state, and last summer I lent him a cow, seeing that he would be able by proper attention to have kept her in the house all the year. He had not been possessed of one for years, perhaps never in his life; but his conduct did not afterwards show him to be deserving of what had been done for him.

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* When cattle are so tied up that they cannot lick themselves, as is in general the case in stall fed cattle, the itching becomes so great, that they lick themselves, when they have the power of doing so, until they create a sore which injures the flesh. Cattle kept in such a state of continual irritation, cannot, I think, thrive as they otherwise would be likely to do, and shows the necessity of frequent currying, or being allowed the liberty of a straw-yard for an hour or two in the day. In corroboration of this doctrine, I have heard that the practice in Berwickshire is to have stalls calculated to hold two—one half of the stall being under cover, and the other not, so that the cattle not being tied up, are left at liberty, to consult their own comfort, and in this way they are found to thrive much better.

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* Mr. Matthew Hilton, agriculturist to the Marquis of Ormonde, informs me that Drumhead Cabbage sowed in February, and the plants put out in May and June, will keep all through the winter.

He would not sow his rape in proper time, as he was desired, and I was at last obliged to discharge him from the work at Gosford, before he would be at the trouble of doing so. This neglect occasioned the crop to be late coming forward in spring, and having wasted his turnips, in beginning to them before they were ripe, and using them extravagantly, they were all finished before the rape was fit for cutting. This being the case, he turned his cow into the rape to graze, by which the crop was completely destroyed; and this failing, he put the cow to graze upon the young clover. This being soon eat down, I found the animal eating the tender shoots of the young quicks, in one of the new made ditches, when, upon enquiry, all the foregoing circumstances came out. Being provoked at such conduct, I ordered the cow to be sold; but, when the day of sale came, he was able, from the improved state of his farm, to get one of his neighbours to go security for the payment of his arrears, his rent, and the price of his cow; and, also, that he would buy rape elsewhere, and feed his cow in the house, as I required; upon which I did not persist in my intention of selling her. He, accordingly, bought a small piece of rape ground, (ten Irish perches, or seventy yards long, and two yards broad,) which, with a little dry fodder, kept his cow in full milk for thirty days;* and, upon that feeding, gave fourteen quarts daily, whereas, upon dry food, she had fallen off to half the quantity.

I state these particulars to show you the folly and blindness of this man to his own interest. By neglecting to sow the rape in *proper time*, it was not ready to supply the place of his turnips, and every thing went wrong by this first neglect, which appeared to him of no importance. If the turnips had been properly managed they would have lasted out *longer*—if the rape had been properly treated it would have been ready *sooner*; and, if it had not been trampled down, would have lasted until the clover supplied its place, and every thing would have answered in its turn. Now he has been obliged to buy from others, at the rate of fully £10 an acre, that rape which his own land would have supplied him with in abundance, and he has injured his clover so that he will lose half the benefit of it. But the advantage of the rape is seen particularly in this, that, notwithstanding the high price he paid for it, it was better for him to buy it than to feed his cow on *straw*, even supposing he had got the *straw* for *nothing*, which is very easily demonstrated.

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* The immense produce of rape, when *well manured*, is beyond any thing almost that can be imagined, if let stand until it gets into blossom, which was the case in this instance. Manure makes the stalk tender and juicy, which would otherwise be hard and dry, so that if cut into small pieces, not a bit will be lost, and it grows to a height of six feet. I am almost afraid to say that I believe, with the addition of some straw, an acre will keep thirty head of cattle in full milk for a month.

	s.	d.
For the fourteen quarts produced by the rape feeding, at 1½d. a quart, comes to	1	9
The price paid for it cost only 2d. per day, to which add half a stone of straw, 1d. (being at the rate of 16d. per 112lbs. which is above the general price of that article,) and the expense, daily, comes to	0	3
Leaving a clear profit, per day, arising from feeding on rape, of	1	6

Now, when the cow had been fed on straw, she only gave seven quarts, and very soon would have given still less, the price of which, daily, would be only 10½d.; therefore, if he got the straw for *nothing*, he would only have 10½d. a day by the cow; whereas, after *paying for* the rape, he gained 18d.; but if he had to pay for the straw—the cow would require three stone, which, at 16d. a cwt., would be 6d., and deducting this from 10½d. (the price of the seven quarts of milk)—there would only be a profit by the cow of 4½d. a day, in place of the 18d. a day yielded by the rape. The same thing may be proved in regard to turnip feeding in winter. If a cow calves at November, and is fed on turnips, she will keep up her milking; but, if fed on straw, she will fall off immediately to half the quantity. Now, allowing the acre of turnips to be worth £10, which is more than any other crop generally produces, and reckoning the produce at thirty tons, (although, by good cultivation, Mr. Mitchell had fifty-five tons to the acre last year,)—

The five stone of turnips, which I reckon good daily feeding for a milch cow, would cost	2½d.
And a stone of straw would cost, at 16d. a cwt.	2
Total cost per day for turnips and straw	4½d.

whereas, three stone of straw, which she would require if fed on straw alone, at 16d. per cwt. comes to 6d. a day; so that, by the use of turnips in winter, it appears you can feed your cow (after allowing £10 an acre for the farm) at 1½d. a day less than upon straw alone, and you get double the quantity of milk. So that one cow fed in this way yields you fully as much milk as two would give fed on straw, and the manure is also twice as valuable. This ought to show you all the error you fall into. When you talk of *keeping* a cow all the winter upon straw, you merely talk of *keeping* her *alive*—but your object should be to keep her so as to yield you a *profit;* and this can only be done by *keeping her on moist food,* which, I have shown you above, it is more profitable for you to do than to feed her on straw, *supposing the straw was made a present to you.*

Now as such a small space may be made to support a cow by green crops and house-feeding, suppose that any industrious cotter should turn his small patch of ground to that purpose, and even admitting him to have no means of even getting straw to bed her with, yet if he is attentive to gather the weeds growing on the road side, or in the fields adjoining, and use them as a substitute, he will find sufficient to increase the quantity of manure to such an extent, that he will have no difficulty in getting, from his less industrious neighbours, ground to put it out upon, and thus get a crop of potatoes, amply sufficient to support his family, upon very moderate terms—the quantity of manure thus obtained from a cow well fed and kept constantly in the house, being greater than what any one who has not made the experiment will believe; but if the cotter, instead of enriching the land of his neighbours, should have even a field or two of his own, the constant supply of manure would so improve the quality of the soil, that it would yield twice as much as in the way now usually practised;* and, having only a small rent to pay, he would soon become able to buy an acre or two more, and thus gradually advance himself to the rank of those small farmers to whom I am now addressing myself, and would very shortly be possessed of that quantity of manure which would enable him to enter upon a *proper rotation of crops;* without attention to which no farmer, great or small, can get the full return from his land which it is capable of affording.

To make you sensible of this, I would wish you, for sake of example, to suppose a small farmer, holding eight acres of land, having acquired a stock of manure sufficient for one-fourth part, or two acres—he is then able to commence the following rotation:—these two acres are, the first year, planted with green crops, in which are included potatoes, turnips, cabbages, mangel wurzel, &c. according to the nature of the soil and other circumstances. The next year he manures two acres more; and does the same the third year; and in the fourth year the whole farm has been gone over; and, after each manuring, the two acres so manured are occupied with the following succession of crops: first year, green crops, as already stated; second year, oats, barley, flax, or wheat, with clover; third year, the clover to be cut and brought to the cattle, making into hay whatever may be to spare; fourth year, oats, wheat, or barley. The fifth year the same rotation commences again, and the one-fourth part is again placed in green crops and well manured, and the other crops succeed as before. By this means it is evident the farmer gets *four* productive crops from one manuring, and has always *one-half* of the entire farm, viz. *four acres*, in grain; one-fourth, or two acres, in clover; and one-fourth, or two acres, in potatoes, turnips, &c., which is much more than any farm yields according to the present system.

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* This has been clearly made appear by the enormous produce of small patches of land cultivated under the allotment system, patronised by the Labourers' Friend Society, and stated in their interesting publications.

In order to make this rotation more simple, and less likely to confuse you, I have desired *all* the manured land to be laid down with clover, along with the first grain crop; but it is open to the farmer to sow only *half* in clover, and put the other half in vetches,* Italian rye grass, or cabbages, if he should wish to have greater variety of food for his cattle, which is always desirable. *The only thing insisted upon is, that two crops of grain are not to be sowed in succession upon the same ground.* It is also to be observed, that the plentiness of manure obtained by this system of house feeding, will enable you to manure the stubble of the last grain crop, and sow or transplant rape, which will yield a full return, and be off the ground in time for your potatoes and turnips, which, upon the foregoing plan, always succeed the second grain crop.†

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* In this case the grain, when cut, should be immediately stooked upon the side of the field sowed in clover, and winter vetches put in without delay, and as they are cut the following May and June, vetches should again be put in, ridge by ridge, as the others are cut; these will be ready for use from October to December, and will leave the ground fit to bear any crop.

† Potatoes seem to succeed better than Turnips, but Vetches or Italian rye-grass for October feeding is perhaps as profitable as any, particularly where manure is scarce.

And the quantity of food for your cattle may be still increased, by planting with your potatoes, curled kale on the north edge of the ridges, in such manner as that the mid-day shadow may fall in the trench, and planted three feet asunder, a material addition to the autumn and winter feeding will be obtained without injury to the potato crop: and I have seen them left standing in the furrows even after wheat had been sown, and yielding abundantly.* But if this should be objected to, they may be cut down and transplanted into any corner of the farm, to go to seed, which will sell for double the money, perhaps, which any other equal portion of the farm will produce. I wish it, however, to be particularly understood, that I recommend the foregoing rotation, merely as a great improvement upon the present practice, and likely to be very generally attended with success, but not as the best for *every* soil; for I am perfectly sensible the varieties of soil and the varieties of circumstances are so numerous, that there is no possibility of laying down any plan to suit all cases; and I have, therefore, thought it better to obtain the assistance of an experienced farmer, who will call upon you for the purpose of personally inspecting your farms, and giving instructions suitable to the nature and condition of each, not only as to the rotation of crops, but also as to the mode of preparing the ground and putting them in, and also how to cultivate them afterwards, which accurate information, I am of opinion, *nothing but personal communication can supply.* Under such circumstances one would naturally expect to see the instructions given most implicitly obeyed; but in place of this, I have been provoked, year after year, with the stupid obstinacy of many, who in spite of all that can be said to them will delay to thin out their turnips, waiting until the plants may afford a mouthful for their cattle, when by so doing they injure the crop in a manner they will not believe. I have the same complaint to make of the inattention shown to keep down the weeds, and to keep the ground loose about the turnip plants in the early stage of their growth, and indeed as long as any implement can be with safety used for that purpose. I am in hopes the importance of attention in these points is at last beginning to be understood, and that I shall not much longer have the same complaint to make, and beg reference to what is said upon this subject by Mr. Bruce in the Appendix.

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* Experience seems to be in favour of planting the cabbage in place of kale; which will be kept in mind where kale is mentioned elsewhere. (See Jenkins's account in the Appendix.) Cattle will eat even the stalks of the cabbages if cut into very small pieces.

CHAPTER II.

DIRECTIONS FOR THE PRESERVATION OF HEALTH—ADVANTAGES OF CLEANLINESS AND VENTILATION IN THIS RESPECT—DANGER OF NEGLECTING THEM IN CASES OF INFECTIOUS COMPLAINTS—RECOMMENDATION OF TEMPERANCE SOCIETIES—GREAT SAVING BY ABSTAINING FROM DRAM DRINKING.

ALTHOUGH personal inspection and personal instruction must always be most valuable, yet there are, nevertheless, certain fixed principles which every farmer is bound to attend to, and which never should be lost sight of, and these I shall shortly enumerate; but first, I would wish to say a few words as to the preservation of health, without which, the small farmer and cotter are entirely incapacitated from taking advantage of these or any other means to better their situation.

In this respect, I would recommend to you, most earnestly, immediately to remove all stagnant water, filth, and putrid substances, from the fronts of your houses, in order that the door, which is often the only mode of ventilation, may admit pure air. If the floor within is lower than the land without, let a trench be cut all round, to carry off the moisture, and make the house as dry as the nature of things will admit. Let the windows be made to open, so that every part of the house may be thoroughly ventilated; and let the inside and outside, but particularly the inside, be whitewashed as often as can be conveniently done, and let the most minute attention be paid to cleanliness. With these precautions, the health of a labouring man may generally be calculated on except in cases of fever or other infectious complaints, and even against these the foregoing recommendations will be a great protection, *if strictly attended to;* but should any member of the family be attacked by any complaint of an infectious nature, there is little chance of preventing its being communicated to every one, in the house, *if they are neglected.* The fresh air must be freely admitted; the walls whitewashed, and every thing in the house, of furniture, bedding, and clothes, washed and put out, and exposed to the sun and air, and hot lime put on the floor, if there is any damp, to dry it up. When a person is ill of an infectious complaint, the whole air around him is infected, and it is only by admitting the pure air from without, to dilute it, if I may use the expression, that the infection can be so weakened as to prevent bad consequences to those who breathe it. From not attending to this, many complaints, which, at the beginning, were not infectious, become so afterwards, and whole families are carried off, or put past labour, from neglecting precautions which might have been so easily taken. It is observed, that infectious diseases seldom spread in the houses of the upper ranks of society, and it is merely owing to the admission of fresh air, and the cleanliness which is observed: and the same will account for the safety of physicians and attendants in hospitals, where there are hundreds of patients collected; whereas, if fever once gets admittance in a poor man's cabin, the infection is preserved by the moist and putrid matter without, and the damp and dirt within, and is rendered more and more malignant by the want of a circulation of air, until, in general, it attacks the whole family, and, even if it does not occasion their deaths, it so weakens their strength, and, by repeated relapses, continues to hang over them so long, as eventually to reduce them to poverty and wretchedness; all which, in most cases, would probably have been prevented by a timely attention to what has been here recommended.

But cleanliness and ventilation, however valuable they may be as the means of preventing or banishing disease, cannot be as effectual as they ought to be whilst the use of ardent spirits prevails in the degree it now does.

I need not take up your time in expatiating upon the consequences attending this ruinous practice—those who are even most addicted to it are fully sensible of its injurious tendency, but think it is in vain to struggle against it. Nothing, however, can be more contrary to facts and experience than such a belief. It is only a few years since some benevolent people in America first started the idea of forming what are called *Temperance Societies.* The hopelessness of such an undertaking was so much the belief of the public, that the attempt was ridiculed as absurd and visionary; but it has, nevertheless, proved quite the reverse. Thousands have been thereby reclaimed, and are now enjoying a degree of comfort and happiness before unknown to them. Even among sailors, (a class of people least likely to be operated upon,) members are now enrolled, and *temperance* ships are manned from New York, without difficulty, for the longest voyages. From America the plan has extended to Scotland, and *temperance* ships are now, in like manner, sailing from Glasgow, and numerous societies are spread over the face of the country. From Scotland, the plan seems to have crossed over to the North of Ireland, and societies are already in existence in this very country; therefore, with such numerous examples of successful resolution before you, both abroad and at home, I most earnestly beg of you to make the attempt, and trust you will not show less firmness than so many others have proved themselves to possess. Subjoined you will find what a list of desirable articles of clothing may be bought with the money, which it would cost you to indulge in a single glass of spirits daily. When you read it over, think of the short-lived, selfish gratification you derive from the practice, and think of the *permanent* comforts of which you deprive yourselves, your wives, and your children thereby, and at once determine to abandon the use of spirits; and, take my word, you will soon find the benefit of it, both in your health and circumstances.

ONE GLASS OF WHISKEY PER DAY, commonly called by drinking men, "*their morning,*" costs (at three halfpence per glass,) no less a sum than two pounds, five shillings, and seven pence halfpenny, *yearly!* which sum, if laid by, would provide the following comforts and necessaries of life for a family, viz.:—

One pair of large blankets	£0	10	0
One pair of sheets	0	6	0
Two pair of shoes	0	12	0
Two shirts	0	4	0
Two neck handkerchiefs	0	1	1
Two pair of stockings	0	2	3
One hat	0	5	0
Cloth for trowsers, and making	0	4	6
Change remaining	0	0	4½
	£2	5	7½

CHAPTER III.

MAXIMS OF UNIVERSAL APPLICATION IN FARMING—AS TO DRAINING, DESTRUCTION OF WEEDS, CROPPING—MANAGEMENT OF MANURE HEAPS—SQUARING ENCLOSURES—LEVELLING USELESS DITCHES—HORSES NOT SUITABLE TO SMALL FARMS—CONSUMPTION OF STRAW IN THATCH.

HAVING said thus much upon the foregoing subject, of such first rate importance to the labouring classes, I proceed to give a list of those maxims in farming, which are of universal application, as far as I have been able to collect them:—

1st. The ground must be thoroughly drained. For this purpose it is not sufficient to cut drains in the low grounds; but the springs must be sought for as high up as any symptoms of them can be discovered, and the water conveyed from them, and not allowed *to force its way through the soil;* in which case it will destroy the effect of any manure which may have been applied. In proof of which, you may always observe, in such situations, the grain in that part of the field ten or fourteen days later than the rest of the crop, and in very late seasons it may, perhaps, not ripen at all.

2dly. The weeds must be destroyed; which in a little time will be accomplished by proper attention in collecting, as far as possible, all weeds, *before* putting in the crop, and by sowing the green crops in drills,* and carefully weeding them afterwards; and they may even be máde worth the expense of gathering, as they will yield a valuable addition to the manure heap, if applied as bedding in the cow-house. For this purpose, they should be collected before flowering. It is shameful to see, in many fields, the quantities of rag-weed ripening to seed, and impoverishing the ground as much as a crop, which might, if usefully applied, as above directed, have brought nourishment to the soil, in place of exhausting it.

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* I have already mentioned the practicability of getting an early supply of the leaves of curled kale in autumn, by planting them with the potatoes in the edge of the ridges, and I should think that to be the best plan for such a purpose: but to plant the potatoes in drills is a much more effectual way of cleaning the land, and is, therefore, much to be preferred on that account: and curled kale or cabbage for winter use may be cultivated in this way, by planting them at the edge of the broad ridges, as hereafter recommended.

3dly. All cattle must be fed in the house or straw yard, upon good food; such as rape, cabbage, turnips, mangel wurzel, potatoes, clover, and vetches, in proper succession, will abundantly supply, according to the nature of the land; there being no farm in which some of these crops may not be raised in abundance, with the aid of manure, which the practice of home feeding produces.

4thly. Never take two crops of the same kind in succession off the same land, although this is sometimes done with potatoes, to reclaim land that has never been in cultivation; but in other cases this is not advisable; and, in particular, two grain crops cannot be taken in succession without injuring the soil, and in the end a manifest *loss* arises from the practice, in place of that *advantage* which the needy farmer looks for; because, by interposing a *green* crop, such as clover, &c., full as many *grain* crops may be had off the same piece of land and from the same manure, in any given number of years, by taking them in *rotation*, as by taking them in *succession*. But the rotation system has this advantage, that while you get as many grain crops, you keep the land always in good heart, and between the corps of *grain* you get *green* crops equally valuable. This is accounted for by considering that no two crops derive the same particular nourishment from the land. The roots of some sink deep, and draw their nourishment from the bottom, while others spread on the surface; and it is generally believed that plants derive their food and support from as different ingredients in the earth, as the different kinds of cattle derive their food upon the surface. Horses will eat grass which cows reject, and so with every description of cattle; and supposing the analogy to hold good in plants, it is easy to conceive that a change of crop may find the soil abundant in that kind of nourishment which it requires, although it might be, at the time, exhausted of that kind required by the crop which had gone before; and thus the ground may be as much restored by the introduction of a *green* crop after a *grain* crop, as if the field had actually lain fallow; and experience, in a great degree, justifies this reasoning.

I am fully sensible, however, that a system of over cropping with grain will extract *every kind* of nourishment from the soil, and leave it so that *it will not even yield grass.* This is the case with the land which is left to *rest*, as it is called by those who take three or four grain crops in succession; and the phrase is well applied, for the land is really not fit *to do any thing.* The error of this class of persons is, that they turn the land to grass at the *end*, in place of the *beginning* of their course. Had *grass-seed* been sown with the *first crop of grain*, there would have been a good crop of hay, and good after-grass, and the second crop of grain would have been as good as the first; and this is what ought to be done by those whose land is not suited to clover, or who, from poverty, are not able to buy the clover seed; and even where *two* grain crops have been taken, it would be better to sow it with rye-grass, which will yield a crop on very poor land, rather than leave the ground to be possessed by weeds and such herbage as may naturally rise. The fact is, the last exhausting crop should only be put in upon that portion of the farm which is intended for potatoes, and other green crops, the succeeding *year*, which crops then give the manure to restore it to a productive state; and by this means there is no land at all lost by what is called *resting* it.

5thly. The place for manure should be contrived so that it should not be exposed to any accumulation of rain water, but should receive the contributions from the sewers of the house, stable, cow-house, &c. The bottom should be paved, so that the drainage of the manure should run into a small cask or well adjoining it. Fresh *earth* should be regularly brought and spread over the manure, and the liquid in the well should be thrown *over it;* by which means the whole compost would be equally rich, and the quantity increased to any extent that could be required; and the steam or smoke which arises from the stable manure, and which is the very richest part of it, would be kept under and imbibed by the earth so laid on, and the quantity of earth should be proportioned to the strength of the dung with which it is mixed. While speaking of manure, it may not be amiss to remark the great loss arising from the practice of letting off the water in which flax has been steeped, which if sprinkled over, or made into compost with fresh earth, would be found most valuable.*

6thly. It should be the object of the farmer, as soon as he possibly can, to have his fences made in straight lines, and of as great length as the farm will conveniently admit of. It is almost inconceivable the quantity of time lost by the frequent turning of the plough, and the quantity of land thrown out of cultivation, by having a crooked irregular fence, the bendings of which the plough cannot follow.

7thly. A farmer who has any understanding must perceive, the moment it is mentioned, that every unnecessary ditch is so much land actually lost, and that his care ought to be to have as few of them as possible; and it will, therefore, occur to him, that if he feeds his own cattle in the house, all his ditches may be dispensed with, except the mearing ditches, which are necessary to keep out those belonging to other people; and this would enable him to raise hedge-rows, which never can be done if the cattle are turned out, the value of which, for shelter to his crops, and supplying him with timber for all country purposes, is most important.† The loss of land from useless fences is greater than any one would suppose who has not considered it: and I would almost venture to say, there are farms in this country of twelve acres, in which the ground lost between the trench or gripe, and the backs of the ditches, together with that lost by the crookedness of the line, would amount fully to one acre, or one-twelfth part of the whole.* Now, supposing a farmer to pay thirty shillings an acre for his land, he of course loses thirty shillings annually by this waste of the surface, which is equal to two shillings and sixpence an acre upon his entire farm. It is quite evident, therefore, that these ditches should be piped and levelled in, which would have the additional advantage of relieving the crops from the vermin to which those ditches afford a shelter.†

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* At the time the flax is taken out of steep, all the rivulets in the country are strongly impregnated with the contents of the flax holes, and those through whose lands such rivulets pass, would do well to turn the stream, where it can be done, over their after grass, or use it in watering their cabbage, turnips, &c. the advantages of which would soon be perceivable. The richness of flax water is fully shown by the growth and colour of the grass where flax has been spread to dry. I have seen a most luxuriant crop of oats upon land irrigated with flax water, although a SECOND crop; which shows that if this manure was preserved, one of the greatest objections to the growth of flax would be removed.

† When a thorn hedge is planted, the lateral, or side shoots, should only be trimmed until the leading shoot has attained the full height you wish it to grow to; if the leading shoot is cut sooner, the hedge will never acquire the same strength. Cutting the lateral shoots is quite sufficient to keep it thick at the root, if properly weeded, and if trimmed every year, it will become so solid

One argument generally used against levelling all inside ditches is, that the cattle cannot be turned out to eat what is called

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that birds will not find shelter in it: thorns may be leared down so as to fill any blanks that may have taken place, and if a part of the bark is left uncut, they will certainly take root if covered with earth; or the hedge may be doubled, and rendered quite impenetrable, by learing back the entire hedges, cutting the stems but half through, and covering them with earth. By this treatment there will be a young growth from the root part, the same as if it had been entirely cut, and there will also be a growth from the lear which has been carried through the back of the ditch—the earth removed by so doing being again replaced. This I have seen most successfully practised in the grounds of the Rev. Francis Gervis, of Cecil, county of Tyrone.

* I have known people object to this, by stating all the trouble they had taken, and the labour they had expended in making them; but if you were to meet with a man who on a journey had gone out of his road, and you pointed out to him his mistake, would you not think him very absurd if he refused to turn back, merely on account of the labour he had undergone in walking so far astray, and rather persist in going wrong, than turn about to go right? It is just the same with the man who objects to level the useless ditch—he has gone wrong, and refuses now to be set right.

† There is no change whatever that will at once produce such an improvement in the appearance of a country as the levelling the crooked fences, and enlarging the enclosures: in proof of which, I would refer you to the appearance of the Glebe land in Mullabrack, and the farms of Bradford and M'Cammon, in Druminnis, and Cullons and Mallon, in Ballindaragh. The improvement is such, that no one who knew these lands formerly would recognise them to be the same he had then been acquainted with.

the *fog*, or food which is to be found among the stubble after harvest; but the gain supposed to be derived from this practise is very much overrated. In the first place, ploughing it down immediately will be of much more use to the land than any advantage to be derived from it as food; for a cow turned out in a cold or wet September day will be put back in her milk more than would pay for her entire day's feeding in the house. Secondly, upon *clay* soils the injury done to your land by the tramping of the cattle, besides the water retained so injuriously in their tracks, is beyond any thing you can have an idea of. Consider for a moment, and ask yourselves, why it is in the light sandy or gravelly soils, that sheep farming is found so beneficial. You are perhaps not aware of it, but if you went to Scotland you would see upon soils of this description, hundreds of acres sowed with turnips, intended to be fed off by sheep, folded on the ground, principally with a view to have the lightness of the soil corrected, from their tramping it into a kind of paste by the constant action of their feet; and owing to this process, the farmers there obtain a tenacity of soil, which enables them to grow afterwards corn crops, which their land would otherwise never yield: but in a clay soil there is too much tenacity belonging to it naturally, and, therefore, tramping, which makes it still more tenacious, directly and most decidedly injures its fertility. The extent of the injury thus occasioned, may in some measure be imagined, by considering the effect produced by the tramping of so light an animal as a sheep; and from that to calculate what effect must be produced by the weight of a cow, an animal so much heavier. The fact is, clay land poached in this way is so puddled, if I may use the expression, that every track is water-tight, which shows that the soil is completely closed against the influence of the atmosphere; the bad consequence of which is exemplified in note, p. 59.* I wish to address myself to your natural good sense, and would ask you, if the use of lime and manure, which you are all fully aware, makes land of this kind loose and open, and by so doing, renders it fruitful: must not upon the same principle, the tramping of cattle, which has the opposite effect of binding and compressing the soil, render it *unfruitful*, and counteract the effects of all that lime and manure, which at so much expense and labour, you have, perhaps, but a year before laid on it. I trust, that by representing this inconsistency, you will abandon the practice, and for a proof of the truth of the observations I have made, I will confidently refer you to the appearance of the soil, when ploughed up from clover lea which has not been pastured, compared with that which has; or with stubble land which has been trodden down by cattle in the manner I object to.

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* See this subject more particularly alluded to, page 86.

8thly. It requires a farm of fully fifty acres to give sufficient employment to a pair of horses; perhaps sixty would be nearer the truth; and, therefore, if a farmer even ploughs in partnership, he ought to have twenty-five or thirty acres. I here speak of those who have no other employment for their horses than what the cultivation of the farm affords.* There are, however, cases where the distance of fuel, and distance of lime, may make a horse necessary when it might not be otherwise. All *small* farmers ought to use the spade, for many reasons. It costs but little more, even if he has to hire assistance, and does the business better, and the crop is better. In all drill crops, also, by using the spade, he may put in a quicker succession of crops, and have one coming forward as the other is ripening. In wet seasons he can dig, when he cannot plough; and its value, in turning up stiff clay lands in autumn, and exposing the soil to the frost and snow, is scarcely to be imagined; and in all such lands *this plan* should be pursued where no winter crop is put in.

9thly. In all wet lands, and where the clay is retentive, the ridges should be narrow, which may, indeed, be almost laid down as a general rule, in a climate so moist as this; but where the land is sufficiently dry, the broad ridge is preferable.

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* Martin Doyle estimates the ground required to feed a horse, at two acres, and the value of food and other expenses at £20 8s. 2d. yearly. The small farmers in the counties of Down and Antrim adopt the plan of buying a young horse rising three or four years old, and having used him in their spring labour, they sell him off in May or June, and the natural improvement in the animal at that age, generally leaves them a profit, besides getting their labor done for the keep.

10thly. No hay or straw whatever should be sold off the farm. In England this is strictly forbidden by lease, and the tenant who did so would be supposed to have an intention of running away. If the cattle are home-fed, as here recommended, all the straw the farm can be made to produce will prove little enough; and for this reason, as soon as the farmer is in circumstances to enable him to do so, it would be his interest to slate his house and out buildings, which, in the end would be found the cheapest roof, and would preserve, for the use of the farm, the large quantity of straw which is annually consumed in repairing the thatch.

CHAPTER IV.

GENERAL OBSERVATIONS UPON THE MODE OF CULTIVATION AT PRESENT IN USE AS TO POTATOES, TURNIPS, FLAX, AND WHEAT—ADVANTAGE OF LAYING ON LIME WITH THE POTATO CROP, AND GIVING HOUSE MANURE TO RAISE TURNIPS—NECESSITY FOR STOPPING THE SPREAD OF RAGWEED, COLTSFOOT, AND THISTLES, BY MEANS OF THE SEED—USE OF CHAFF AS AN ALTERATIVE FOR CATTLE.

HAVING laid down these general maxims, the propriety of which I think you cannot but admit, I should wish to lay before you some observations which have occurred to me in visiting your farms: the first I shall make, is upon your mode of ploughing old lea for oats; when this is done, you form so many hintons by ploughing each ridge separately, that nearly a seventh part of the entire surface is stripped of the good soil, and when the crop comes up, you will see the braird confined almost exclusively to the middle of the ridge, where the good soil is gathered in, and though it afterwards spreads, still a very considerable loss arises: now, if instead of ploughing each ridge by itself, you would take in six or eight, you would still preserve the land in the same form, but there wouldbe only one hinton in the whole, in place of one for each ridge; so that the surface not being deprived of the good soil, would give the crop evenly over its whole breadth. You should also observe in all ploughing for grain, to be particularly careful to turn over the furrow slice, with such an inclination that the top exposed to view should as nearly as possible resemble a ridge stone in appearance, by which means the furrow slices will pack close, so as to prevent any seed escaping, and the angle at top will afford sufficient mould for the harrow to turn over and cover the seed.

This inclination of the furrow slice is very material, and is produced partly by the shape of the mould board, and partly by the skill and judgment of the ploughman, proportioning the *breadth* properly to the *depth* of the furrow slice; the *broader* this is in proportion, the more flat the slice is left, and the narrower it is the more upright; and the closer the coulter is adjusted to the sock, with a slight inclination to the left, the more perfect the angle or comb, as it is termed, will be at top.

Next, as to your potato crop, which ought to follow your oat crop after lea—your present mode of cultivation is either in ridges or drills: the advantage of the former is said to be, that the potatoes are of better quality, but it is generally admitted, the produce is not so plentiful—that it always requires a great deal more manure—that the weeds cannot be so well eradicated, nor the ground so well fallowed as it is by the latter—and also, that in dry seasons, any partial fall of rain runs off without reaching to the roots of the plants; on the other hand, in the drill way, the potatoes, generally speaking, are more plentiful, but they are not usually so dry, and in rainy seasons they are more liable to be injured by superabundant moisture. Now, a mixed system of cultivation appears to me likely to unite the advantages of *both*, and to be free from the disadvantages of *either*; and I recommend, for this purpose, that you should throw your land into broad ridges, of twelve to fourteen feet, and then plant your potatoes* in regular drills across them, slanting the course of the drill according to

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* It appears from a series of experiments given in the Second Edition of the Encyclopediæ Metropolitanæ, that *drilled* potatoes yield the greatest produce when planted in drills thirty inches asunder.

The experiment seems to have been made with great care, the potatoes used were pink eyes, and the manure forty cart loads per acre, and fresh horse-dung was tried against rotten cow-dung. It deserves to be noticed, that the produce from the fresh horse-dung and rotten cow-dung was not equally affected by the spaces between the drills; for example,

	Horse dung.	Cow dung.
At 30 inches apart produce	66 bolls per acre,	66 bolls per acre.
24 ———	60 ——	61 ——
18 ———	51 ——	60 ——
12 ———	47 ——	42 ——

I believe the distance between the drills, ought to be regulated by the length of the stalk, which depends on the kind of potato and the strength of the manure, and that the drills ought not to be closer together than the length of the stalk; this would generally give twenty-six to twenty-eight inches for the distance, and if highly manured fully thirty inches, except in such early kinds as ash leaf, kidney, &c. which are dug before fully ripe.

Some opinion may perhaps have been expected as to the cause of the recent failures in the growth of this crop, but I confess myself unable to account for it in any way; the treatment which now fails has been successfully practised, the lay of the land, so as just to give sufficient fall to the furrow to carry off any moisture that might be injurious, and at same time retain as much as might be useful. It is evident that, in this way, in wet weather, the trench will prevent any water from lodging, and that in dry seasons, the furrow receives the slightest shower, and conveys the moisture direct to the roots of the plants. The drill also, in this way, admits the use of the hoe and the scuffle, by a person standing in the trench, which cleans the ground with less trouble, and much better than it can be done by hand weeding. You are also enabled to mould up higher, which it is a great object when those kinds are cultivated in which the increase *grows up the stalk*, as, in such cases, the higher you mould, the greater produce you have, and in digging out (as you know where to put the *spade*) there will not be seen so many potatoes cut—but in any case, a *four pronged grape* is much preferable to the spade for this work. It appears to me, by following this plan, you would both gain in produce and save in manure, and your land would get better tillage, and be left in a cleaner state; and when the farmer has the command of a plough, there is nothing to prevent its being used in the preparation of the ground, marking out the place for the trench by a furrow. In regard to the cultivation of this crop, I should also wish to recommend to you the practice of putting your manure in the ground, as opportunity offers, through the course of the winter, as soon as it is made, and leave for spring only the work of dropping in the seed at the back of the spade, which any boy or girl can do, by which means you will have the potato setting over before, I may say, you are now in the habit of beginning to it. By following this practice, there will be a prodigious saving of manure, as you may readily prove, by making the experiment of putting out twenty loads, or any other particular quantity of manure, and measure the ground it sufficiently covers,

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both in planting and preserving for a century, without any bad consequences arising, and the uncertainty of the growth at present appears quite incapable of being explained.

I have suggested at last Markethill meeting, that better seed might perhaps be obtained, by allowing a portion to remain undug in the ground, and this is likely to be extensively tried this season, but with what success it is not yet possible to say.

then put a similar quantity by itself, in a heap, and let it remain until the May following, and measure how far it will go. I will venture to say, it will not manure half the space, and the land manured at November will be found to give the best and *earliest* crop. Care, however, should be taken during the dry weather in autumn, to clean the ground of weeds; and it must be seen that the litter has been completely incorporated with the manure, so as to ensure a proper fermentation in the ground. In order that the potatoes shall be of good quality, it is very material that they should be fully ripe before the frost; to accomplish which, the planting ought to take place in the month of April. When the frost comes on while the crop is in a growing state, the plants are killed before they arrive at maturity, and are consequently wet, and without nourishment. It is a great mistake to suppose, because potatoes planted late in May often give a more abundant produce, that the crop is, therefore, the most profitable. Many people say they will do well enough for feeding pigs and cattle, but a good dry potato is just as superior to a wet one, as food for your pig, as it is for yourselves; and if you put wet and dry into a basket together, the animal will soon show you that he knows the difference.

Next to the potato crop, which forms such a large portion of your own food, comes the turnip crop, which affords the most wholesome food for your cattle; in regard to which, I must say, that great inattention prevails. There are four things in the cultivation of turnips which you ought to be most particularly careful of. First, to have the ground in a finely pulverised state:* this is much more easily accomplished by ploughing up the land roughly and deep before the frost than by any other means. Secondly, to force forward the young plants into rough leaf, in order to secure them against the ravages of the birds, who are apt to pick up the seeds just as they are bursting, and the attacks of the fly, which the crop is liable to, until the rough leaf comes out.* The best way to accomplish this, is to put out the manure in a heap in the field a few days before putting it into the drills, shaking it out very lightly, and if very dry, sprinkling a little water over it: this will produce a new fermentation, and when it begins to smoke, then is the time to put it immediately into the drills and cover it up, and sow the seed without delay.† The warmth thus obtained will force the plant into rough leaf in the course of forty-eight hours; whereas, if you put the dung in cold, (it being generally what is old and well rotted that is used,) the fermentation is slow, and the plant will not be out of danger perhaps for a week. Thirdly, to keep the ground clean of weeds: this should be done by cleaning the land *before* the turnips are sown, as much as possible, and watching their growth afterwards, and by the scuffle or horse-hoe cut them off before they can choke up the crop. Fourthly, to keep the ground constantly loose and open about the plants, by stirring the ground between the drills in dry weather. It is quite extraordinary the universal prejudice that exists against stirring the ground between the drills in dry weather, in summer, which, it is said, lets the heat more easily penetrate into the earth; now, the very reverse of this is the case—the oftener the ground is stirred, the less it will be affected by the heat.* Land, in a pulverised state, imbibes the dew and damp of the night, the exhalation of which, by the warmth of the following day, produces a moisture round the plants, which nourishes and invigorates them in a most remarkable degree; whereas, if left unmoved, it often, particularly in clay land, gets baked so hard, that no plant can thrive in it. Let the experiment be made in a plot of cabbages, and dig carefully between the rows at one side, and compare them with the others which are left untouched,. and you will soon see the difference; in fact, if you will take the trouble to observe a drill of cabbages, when the earth is first turned up after long parching weather, you will perceive, before it has been done two hours, that the leaves have assumed a more lively colour, and will look more vigorous than they did before; and you may rest assured that, in dry weather, every drill crop is improved by having the soil turned up as often as practicable, provided you do not disturb the roots of the plants.

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* It sometimes happens that severe frosts in June heave up the ground, and raise the roots of the young plant out of reach of the manure; the immediate consequence of which is, the sickly appearance of the crop. The drills should in this case be rolled without loss of time, to replace the plant solidly in the ground. When a roller cannot be obtained, a small round block may be substituted for the wheel of a wheel-barrow, and some stones being put in the box, let it be wheeled over the rows; or if this cannot be got, let two people, standing opposite each other, press down the earth with their feet. I have seen crops recovered by these means, which in a few days would have entirely withered away.

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* A writer in the Mark Lane Express, of the 17th March, 1837, states that immediately upon the first appearance of the fly, he applied the horsehoe as close as possible to the plants, the disturbance occasioned by which put the entire swarm to flight, and the same success attended this application elsewhere. John Hogg of Drumgaw, states to me that he had banished them by rolling the drills very early in the morning, which he conceived had crushed them when in a torpid state from the cold; but it may be a confirmation of the above, the disturbance of the roller affecting them more directly than that which the horsehoe could be supposed to produce.

A writer in the Irish Agricultural Magazine, asserts most positively, that to take lime in its most caustic state, being just slacked, and then sifted very fine, if scattered over the young turnip plant or any other plant when the leaf is wet, the plant will not be at all injured, but the fly will be entirely destroyed; and in like manner, it will destroy all kinds of slugs and insects if used in the evening, when the ground is wet with rain or dew, and the same plan will kill insects on peach, and other fruit trees.

† When a bad ploughman makes his drill in the first instance crooked, he sometimes strives to remedy the defect in covering in the manure. This will help the look of the furrow, but it puts the top of the drill off the top of the manure, and the crop misses, without the reason being perceivable.

The flax crop seems next to claim attention. This was once the crop perhaps of the greatest importance to the North of Ireland, but the introduction of spinning mills having almost entirely destroyed hand spinning, which had afforded a market for the home growth; remunerating prices can no longer be obtained, the spinning mills on the east coast of England, finding it more advantageous to procure their supply from Russia and Holland.

The necessary result has been, that from the period alluded to until the year 1834, this valuable crop has been nearly lost to this country. About this latter period, several spinning mills had been erected in the neighbourhood of Belfast, and to this circumstance was attributed a great increase of demand and advance in price, which, however, afterwards appeared to have arisen from a great failure of the flax crop having taken place on the Continent; this revival of demand caused an immense quantity to be sowed in spring, 1835, for which high prices were obtained; and in spring 1836, all the wheat land almost in the North of Ireland was turned to the cultivation of this crop, but the continental crops having again become abundant, the price has been ruinously low, and it has been made again evident, that under ordinary circumstances, the *home* grower cannot compete with the *foreign*, who, having the advantage of cheaper land, and cheaper labour, and water carriage to the English market, free of any duty, will always be able to undersell us, until protection is afforded. I therefore cannot recommend at present the cultivation of this article, but if protected to the same extent as grain, it would become again one of the most important crops which this country produces.

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* It is a fact well known, that drill crops in a sandy soil are much less injured by long continued dry weather than those in clay soil. What is the reason of this? Is it not that the nature of the soil keeps the ground about the plants loose and open? Does not this point out that artificial means must be taken to keep clay loose and open also, in order to prevent injury from the drought; and this can only be done by ploughing or digging the land before the frost comes on, which will pulverise it effectually; and afterwards, when the crops have been sown, when dry weather comes on, to turn it frequently, in order to prevent its being baked into a flag by the heat of the sun. With this mode of cultivation, clay land, in a dry season, will produce one-half more potatoes; and without it, scarce any crop of turnips can be expected at all in such soils.

The great complaint made against its extensive cultivation is, that it leaves nothing behind in the way of straw for manure; but I am well convinced if the practice was adopted of watering the flax ground with the water in which the crop had been steeped, it would enable the land to give any other crop in succession, or would secure a most abundant crop of clover, (which should always be sowed with it,) and a luxuriant crop of wheat afterwards, this practice being pursued, it might be grown to a very considerable extent without injury to the soil, should any change of circumstances again enhance the price. In regard to its cultivation, the general belief in this neighbourhood has been for many years past, that in order to cultivate it successfully, it must be sown on old lea which has been broken up by potatoes, set in the lazy bed way, and that the *firmness* of the *bottom* is what insures the good crop. It is likewise conceived that the use of lime is exceedingly prejudicial. Now I am strongly inclined to think that both these opinions are erroneous, and that it is not the *firmness* of the *bottom* but the *freshness* of the *ground* which is beneficial: and as these two things in breaking up old lea usually go together, the cause of the good crop has been mistaken. In Flanders, where the finest flax in the world grows, it is proved by Mr. Radcliff's account of the Flemish agriculture there, that the land intended for the flax crop is ploughed and harrowed over and over again, and heavily rolled both before and after the sowing, until the land is brought perfectly level,* and as fine as powder. This shows that all which is said about having a solid bottom for the root to take hold of, is quite ideal. Then, in regard to the prejudice against lime, I consider that it is completely disproved by several instances which have come to my own knowledge very lately, for example, David Greer, of Colrust, had flax of extraordinary length and fineness, and he sowed it upon potato land that had been previously under cultivation, and had been manured in the usual manner with dung, upon this he spread the lime warm from the kiln and harrowed it in, and then sowed the seed and harrowed it again. The crop was the finest that could be imagined, and he has since pursued the same plan with every success; and what shows that the goodness of the crop was owing chiefly to the lime was this, that the places where the loads of lime were emptied, could be traced by the superior luxuriance of the growth; but the land had never been limed before, nor had it borne flax for many years. The Flemish rotation only admits flax once in seven years, and this is often enough for lime also. John M'Clure, of Drumahee, set his potatoes on lime and soil, and some dung, and sowed flax afterwards, and had an excellent crop likewise. These instances show that the existing opinions to which I have alluded are without foundation; and I would strongly recommend that you should not be deterred from the use of lime as a manure for growing flax by any such reports, only attending to this, that once in seven years is fully often enough either for one or the other: and it appears to me that the *real* advantage attending the crop upon old lea is, that it insures the lapse of a certain number of years between the two flax crops, and a fresh soil for the lime to act on. I should consider that to manure the stubble of a grain crop in the end of August, taken after clover, and sow upon it winter vetches, and as you cut the winter vetches the following May, to sow spring vetches ridge by ridge as the ground is cleared, would be as good a preparation for flax, the following season harrowing in lime with the seed, as any other that could be named: but as I have not tried it, I only propose it for your consideration by way of experiment, but of the result, I have not myself the least doubt. In Flanders they use liquid manure, consisting of urine preserved in vaults under the cow houses, with a quantity of rape cake dissolved in it; this immediately incorporates with the soil, and the flax crop receives the full benefit of it. Now, in the way I have suggested, the ground is manured for the *winter* vetch, and being followed by the spring vetch, this insures the incorporation of the manure fully with the soil, without being in the least exhausted, for vetches leave the ground better than they find it, and refresh the soil more than three or four years lying out in poor pasture; so that it appears to me, the ground would be in the very highest order, if ploughed or trenched up in the winter, and again well ploughed, harrowed and rolled, before putting in the crop, as already stated to be the Flemish practice.

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* The advantage of having the ground quite level is, that it ripens equally, and grows to the same length, which are both material points to be attended to in a flax crop, and cannot be obtained where the ridges are much rounded. The ground, of course, must be sufficiently drained.

The next thing I wish to remark upon, is your mode of proceeding in the cultivation of wheat. The customary mode is either to put in the crop directly after potatoes, or first to take a crop of flax, and after it sow the wheat, adding some lime harrowed in with the seed; or a third way is, to fallow the ground intended for it, which however is but rarely practised; but in any case, you almost invariably trench up the land in ridges, with such sharp edges, that you cannot without very particular care, *apply the harrow in spring. This practice*, though heretofore almost unknown to you, is of infinite service to any winter crop, by breaking the crust formed on the ground by the heavy rains, and opens the surface to the influence of the atmosphere, at the same time earthing up the plants, which being rolled* in the course of a few days, will afterwards grow with double vigour. This mode of trenching with sharp edges is by no means necessary. Even in the wettest lands, the ridge may be left in such a shape as will protect the edges from being too severely acted on by the harrow, and the advantage to be gained by this operation is not confined merely to the wheat crop, but you are enabled thereby to sow, at same time, clover and grass seed. This form of the ridge is superior in another point of view also, for where severe frost succeeds to heavy rain, which often occurs, the frost penetrates at the edge of the ridge both by the surface and the side of the trench, and blows up the ground, raising the young plants with it, which taking place repeatedly in the course of the winter and spring, materially injures the plants, and accordingly you will generally find those next to the edge most sickly and delicate; and the injury does not altogether end there, for if an early drought takes place, it enters the ground in like manner, both by the side and the surface, and reduces the soil to such an arid dry state, that the plants are again injured for want of moisture. These are strong objections to the mode of trenching up the ground, which generally prevails at present among you. But my grand objection is, that it deters you from using the harrow so as to put in clover and grass seed; and by not doing this you are at present driven to the necessity, most commonly, of putting in a crop of oats after the wheat, and so take two grain crops in succession, which is contrary to the fourth rule laid down. Your land thus becomes exhausted, and as you have not (according to your present mode of feeding your cattle) manure to potato the whole of it again, there is no alternative left you but to let it out to rest (as you term it); in which state it remains worth little or nothing, perhaps for several years, before you can get manure to spare to bring it again into cultivation; whereas, if it had been sowed with clover and grass seed, the practice of house feeding, which this would enable you to have adopted, would always supply you, as I have elsewhere observed, with plenty of manure, and you would have had the second grain crop, after the clover, much superior to what it would have been after the wheat.

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* Take care not to roll until the crop rises after the harrowing.

Those who, from not paying attention to these considerations, have not put in clover with their wheat, should, nevertheless, upon no account, put in oats: let them sow a crop of vetches or field beans, which will leave the ground in a fine state for either oats or barley, and then it ought to return to potatoes or turnips, and undergo a new course of cropping.* Under this second mode of cultivating wheat, you manure both for it and for your potato crop, and these two manurings give you first potatoes, then flax, then wheat, then vetches or beans, and lastly, grain—that is, you get *five* crops from *two* manurings; but in the rotation I have suggested, the *one* manuring gives you potatoes, grain, clover, and grain again—that is, *four* crops from *one* manure, which is evidently a better return than the other. I recommend it also more particularly on this account, as it keeps one-fourth of the land always in clover and vetches, by which means, due provision is made for the accumulation of house-manure; for it cannot be too often urged upon your attention, that lime must not be applied, year after year, to the same land. Many of you think, from witnessing its first effects, that you can always have recourse to it with the same success; but in this you will most assuredly be disappointed, and if persisted in, will bring your ground into such a state that it will produce nothing—once in six or seven years is sufficient to apply it with advantage, but it never will produce the same effect as at first.

It is, therefore, of the utmost importance, that when you first begin to *lime*,† you should raise your potatoes upon *it* and make use of the house-manure, which this leaves at your disposal, to raise turnips or mangel wurzel for house feeding, and increase your stock of cattle to the utmost which this plan will enable you to keep, setting it down for certain, that you ought to have, at least, one cow for every three acres‡ of arable land, as being the

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* A French chemist has lately found, by experiment, that there is a kind of excrementitious discharge from the roots of the bean that is congenial to the nourishment of grain, which is fully borne out in practice.

† It is said, that if hot lime is slacked with pickle, the salt combining with the lime forms a more beneficial manure than it would be if applied in the common way.

‡ I calculate that the milk and butter of a cow will pay the rent of three acres of land of average quality, and if she can be supported upon half an acre

smallest stock which will enable you to keep your land in heart, when the resource of lime can no longer be looked to; if this is not kept in view, from the very outset, you will find you cannot manure the one-fourth of your farm every year, and you will, therefore, be thrown out of the rotation—the land will be exhausted and left out to rest, as formerly; and as it gets poor you will get poor yourselves, and having no longer the relief of lime to fall back upon, your case will become worse than what it is at present; for *now*, by lending you lime, I have no doubt of making you comfortable and independent, if you are only industrious and willing to follow the instructions given you; but *then*, this resource is lost to you, and I do not see what other can be made available for your restoration.

From this digression I return to the *third* mode in use of cultivating the wheat crop, which is sowing it after a fallow—the nature and object of which operation you seem to me, in general, but imperfectly to understand. It would appear, from the practice of many, that they considered the great object of so many ploughings was merely to pulverize the ground, and if you accomplished that, by giving three or four ploughings in quick succession, nothing more was to be desired, without taking into account that the principle of this operation is built upon this circumstance—that in the course of a certain number of years' cultivation, almost all lands will accumulate a certain stock of the seeds of a variety of weeds, which being shed upon the surface, have, from time to time, been turned down by the plough, out of the reach of vegetation, where they will be preserved for almost any length of time, until they are again brought within the influence of the atmosphere, which will immediately cause them to grow. The great object, therefore, of the fallow is, by repeated ploughings, to bring, in

there will be then two and a half acres out of every three, rent free for you to make the most of, with plenty of manure to cultivate them, besides any profit that may be derived from pigs, poultry, &c., and it is from fully considering this, that I have repeatedly asserted that every tenant on these estates might, if they followed the instructions given them, have their potatoes, their grain, and their pork for themselves in place of selling the two latter to pay their rent, as they have heretofore in many cases been obliged to do. See sundry declarations in Appendix upon this subject.

succession, every particle of the soil into contact with the air, and by allowing each crop of weeds to vegetate, and then ploughing them down and bringing up another portion to be served in the same way, completely to free the land from the seeds so accumulated, which can in no other way be effectually done, as they must be allowed to grow before they can be destroyed. It is manifest, therefore, that time must be given between the ploughings to let the weeds spring up, and if this time is not allowed, the seeds are again turned down until a succeeding ploughing may restore them to light and life; this, therefore, should never be lost sight of. The plan, however, of raising wheat after fallow is not very suitable to a small farmer who can seldom bear to lose a year of his land; but it may be adopted in the outset with advantage, for the purpose of cleaning his ground, and enabling him to get into a better system; and it must be admitted that the crop of wheat, after fallow, is very superior, both in quantity and quality, to any other, and will sell perhaps a shilling per cwt. higher than the produce of the same seed sowed on potato land. Before turning to any other subject, I wish to make one further observation upon the wheat crop, which is, that you, I may say almost universally, let it stand until it is over-ripe,* which thickens the skin and spoils both the appearance and quality of the grain. The rule laid down in Scotland to know when wheat is fit to be cut down, is to take a few grains and squeeze them between your finger and thumb, and if there is no milky fluid proceeding from them, the crop ought to be cut, no matter what the appearance of the straw may be.†

Another observation I have made, in going through your farms, is the very little care taken to prevent the spreading of the destructive weed called *coltsfoot*—this is the first plant that comes into flower in spring; you will see the blossom, in the land where it grows, in the month of March, before a leaf is visible, and, in the course of a month or six weeks, whilst the ground is still red, it appears with a white tuft of down, on examining which, you will find a seed attached to each particle, by which it is carried for miles over the country at that season, when the ground is ready prepared for its reception. It is by the sowing of the seed in this way that this weed is propagated, for it makes but slow progress by the root, however difficult it may be to eradicate it when it has once got hold of the ground. This weed also appears to me to grow spontaneously, where the practice of over-liming, or burning the surface to make ashes, prevails. The most effectual way of banishing it, is to pull up after harvest wherever you see the leaf on the ground, as much of the root as can be got out; you will find at the end from whence the leaf grows, two or three young buds, from which the flower proceeds in spring, and by pulling them the flower and seed are prevented; attention to this and pulling also any blossoms arising in spring, will soon clear the land of this most hurtful weed.

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* This observation extends also to oats, particularly the potato oat, which will fully ripen in the stook, and the danger of loss by a shake will be avoided.

† It may not be amiss here to remark, that where any smut may appear in the wheat crop, the grain should be separated from the straw by lashing it, as it is termed, which is striking the heads against a sharp board or rail—by this means the dust flies off without being mixed up with the grain, which the operation of threshing is sure to do—the difference in the appearance of the produce, under the two modes of management, will not be less than one to two shillings per cwt. according to the degree in which the crop has been affected.

There is another weed which I likewise see doing a great deal of mischief—I mean *ragweed.* The quantity of nourishment it draws from the ground is shown by this, that it will not grow upon bad land. In regard to it, a most ridiculous notion prevails, which I have frequently found people possessed of, who ought to know better—namely, that all the nourishment it has extracted from the soil in its growth, is again returned to it in its decay, or in other words, that after ripening the seed, the sap descends and enriches the earth, which is, therefore, left nothing the worse.* I see, also, the cutting down thistles wholly unattended to, and the seed allowed to scatter with the most perfect indifference. In England, a farmer has been known to bring an action against his neighbour for not cutting down the thistles on his farm, and he recovered damages without difficulty. I wish most sincerely, that here, where people seem to be as litigious as in any part of the world, some one would set an example of punishing such wanton neglect as takes place with regard to all the weeds I have alluded to. Thistles are only biennial plants, and therefore, if cut down for two successive years, the supply of seed would be destroyed. I see people employed for whole days pulling up these out of their crops, when half an hour's labour, in cutting down the parent stocks, would have prevented the young growth from ever having come into existence. Besides the weeds just mentioned, there are others scarcely less injurious; such as the yellow flowering weed, known in this country by the name of prussia, but is I think more properly called corn charloch. Also the corn marygold and wild poppy. All these are seldom seen except in land exhausted by successive corn crops. When the land is in this stateit seems to produce them naturally, for they are never seen where a proper rotation of crop is pursued. I believe they are all annuals; and if you will pay attention you will find they are rarely seen to grow to any great extent in the first crop, after the manure, nor after vetches or clover; both which crops leave the ground *in good heart*. When this is the case, the vigorous growth of the crop chokes these weeds, and they are soon banished; but when the ground is poor the weeds choke the crop, and get almost entire possession of the land.

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* The absurdity of this idea reminds me of having been once very urgent with a man to drain part of his farm. which I saw was actually good for nothing, from the neglect of it; and what do you think was the reason assigned for not wishing to do so? It was this—that "if he made drains in his land, all the fat would run away." You may perhaps laugh at this man's absurdity; but the idea that the nourishment extracted by the growth of a plant and the ripening of the seed, can ever descend through the dry stalk, and be discharged again by the roots for the enriching of the soil, is an

There is another matter in which I have also observed great ignorance and inattention shown—that is, in your allowing the chaff of your corn crops to be lost. You will say, perhaps, there can be no nourishment in chaff, and why should we trouble ourselves in that case about it; and it is very true there can be very little actual nourishment in chaff, but there is a great deal of use in it, notwithstanding, which you may soon perceive, if you will consider that when your cow is confined to dry hay or straw in

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absurdity fully as great, if not greater than the notion of the poor man alluded to, who, although you may pity his ignorance, had just as high an opinion of his own judgment in regard to the effect of the drain, as you can possibly have in regard to the ragweed.

winter, after the juicy rich grass of summer, the change of food immediately affects her habit of body—the dung gets dry—the coat stares, and from the costive state of the bowels, without any suspicion on your part, diseases originate which often end in the death of the animal, and may perhaps tend thereby to your own entire ruin. Now, the chaff which you throw away is the very best remedy against this evil, and when well boiled with some potatoes mashed down, and some seeds or bran mixed, to make it palatable, a bushel full given in this way, night and morning, will open the bowels, make the skin look healthy, and increase the quantity of milk beyond your utmost sanguine expectations When chaff cannot be had, chopped hay or straw may be substituted, a machine for cutting which may be bought for about thirty shillings. The mixture should be made of such a consistence as to be easily stirred about with the hand—a greater quantity of potatoes may be given, with advantage, in this way, than in any other, but they must be boiled separately, as potato water is always injurious: the mixture is improved by some Swedish turnips, which may be boiled with the chaff;* but where turnips are given in quantity, they will, of themselves, open the bowels sufficiently.†

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* See Mr. Scott's account in Appendix.

† Another useful article which I see going to waste is the seed of your flax. If you were to stook up your flax like any other crop, and delay watering it until spring, you might save the seed without the slightest difficulty. It is said, however, that the flax will not be so fine and silky in this way; the seed however generally pays from £8 to £10 an acre, which is equal to most other crops and the flax remains over and above, but with a little trouble it may be saved, without that delay, by following the plan pointed out to you some years ago by the Linen Board; but if you do not choose to take that trouble, let the seed be at any rate taken off by rippling, and made use of as is practised in Scotland, for the rearing of calves. The seed, when boiled, forms a rich and nourishing drink, upon which mixed with a little skim-milk, calves will thrive as well as upon any food whatever, except running them on the cow; and it is actually prejudicial to the colour of the flax, if you do not take it off before steeping. If the wetness of the weather should prevent your drying the bolls with facility, a slight drying upon a kiln will at once do the business, and ensure their keeping safe until required for use. It is now generally thought best to let the crop ripen more than formerly, and there is then less loss in the manufacturing it.

In alluding to the loss you expose yourselves to by negligence and inattention in the foregoing respects, I cannot allow myself to pass over what you lose by the manifest neglect of the instructions given in the fifth rule, as to the management of your manure. When I published the first edition of this Address, I certainly did expect that a matter of such importance would have met with *universal* attention ; and yet I am sorry to observe, that at the present day *I see many* instances of a total disregard to what is so plainly your advantage to attend to. It would seem to me some of you have so little understanding, that you suppose if you have a certain *bulk* of manure, you have all you can desire, and that the quality or strength of it is of no importance whatever—never considering that the strength and richness of your manure is soluble in water; and if you allow it to be drenched time after time by floods of rain running through it, there will only be dross and refuse left behind. If you keep the manure from being thus injured, and throw back the seepage, and prevent the evaporation, as directed in the fifth rule, you will preserve it in all its original strength, as it comes from the cow-house; but as an example may perhaps bring this before you in a stronger point of view than in any other way I can put it, let me suppose that some of you should purchase a little tea at a grocer's—as long as you keep it dry and shut up from the weather, it will preserve its original strength, even for years; but when you put it into a tea-pot and pour water on it three or four times, the strength is all gone, and your tea becomes, I may say, dead useless matter. It is just so with your manure. I see it often placed in such situations, that the rain water from your house and offices, and the seepage from the higher grounds, all runs through it; thus every shower floods it day after day, carrying off always some part of the strength, until at length it is left as dead and as useless as the leaves thrown out of the tea-pot. Surely no man in his senses will persist any longer in such gross mismanagement. If you were to observe a man quietly stand by and see *his potatoes destroyed*, which were to be the chief support of himself and his family, you would say he was either mad or a downright idiot; and if this would be your opinion of *him*, what can you think of *yourselves* when you stand by and daily look on at the destruction of that manure by which *your potatoes are to be produced?*

CHAPTER V.

ERRONEOUS OPINIONS AS TO LAND EMPLOYED IN RAISING FOOD FOR CATTLE—DIFFERENT OPINIONS AS TO VALUE OF TURNIPS COMPARED WITH POTATOES—REASONS FOR PREFERRING FORMER FOR THE USE OF SMALL FARMERS—LAND TO BE APPLIED TO WHAT WILL PRODUCE THE MOST MONEY—GREAT RETURN FROM BUYING POOR SPRINGERS—OBJECTIONS TO CONTINUAL TILLAGE ANSWERED—ENCREASED EMPLOYMENT AND GOOD WAGES AND ACCUMULATION OF PROPERTY THEREBY—NO ONE TO BE DISCOURAGED FROM COMMENCING, HOWEVER POOR.

Were I to allude to every subject which might appear worthy of observation, the length of this address would greatly exceed that to which I propose to confine myself, but I cannot help further remarking, that farmers in this country are apt to judge erroneously in regard to the value of such crops as turnips and mangel wurzel, and other food for cattle, upon this principle, that they are not saleable in the market, and they give an undue preference to potatoes, on account of the money which they can almost in every season command for them. I am far from wishing to detract from the value of potatoes, and the great advantage which arises from their being adapted to the food of both man and beast; but this very circumstance generally occasions their being *sold*, and thus the farm is robbed of the manure, and the future produce curtailed, for the temporary object of raising, perhaps, a trifling sum of money, though the farmer might, in the end, have even made more by *fattening* stock with them (in which respect many prefer them to any other crop,) and have had, in this way, the manure besides. But, if a farmer has plenty of *turnips* and *mangel wurzel*, he is not tempted to misapply them; and they are, therefore, turned to the purpose for which they were intended; and if he has more than is required for that purpose—he buys cattle lean and sells them fat—or he purchases them in good condition, at November, when beef is cheap, and holds them over for a market in spring, when it is dear—or he buys springers in March or April, at a low price, when fodder is scarce, and sells them at May, when they are near their calving, and grass is plenty. In all cases he is sure of a good profit, in money, besides what he makes by manure, which is always most valuable; and both these crops have the advantage of being used raw; whereas, potatoes ought, when given to cattle, to be half boiled, which consumes a great deal of fuel, if used on any great scale. It is a disputed point whether turnips or potatoes are the most beneficial crop,* and great difference of opinion exists among persons holding large clay land farms, where carting off the turnips poaches the ground; and also among those who make a trade of fattening cattle upon a large scale, who have, in several instances, preferred the latter; but, whatever idea the large farmer or the cattle-feeder may entertain, it appears to me, there can be but one opinion upon the superiority of the turnip crop, as regards the *small* farmer.† In the first place, the saving of fuel, to-which I have already alluded, is a most material recommendation. Likewise the late period of the year at which they can be sowed, which admits of their succeeding rape, winter vetches, rye-grass, annual clover, or early cabbage. The Malta turnip may be sown at any time in July with the prospect of a full crop. Thus, it is clear that three crops may be obtained in two years, turnips being one; besides this, it is to be considered that the principal use of the turnip crop to the small farmer, is the support of his regular stock, and the supply of milk and manure. Now, a stone of turnips will yield as much milk and manure as a stone of potatoes, and the same land will yield five or six stone of the former, at least, for one of the latter. Again, when they are applied to fattening, and compared with potatoes sold in the market, (which is the usual mode of disposing of them by small farmers,) it must not be forgot, that the expense and loss of time in driving a fat cow to a fair, is nothing compared to the labour of attending the market with a horse and cart, day after day, to sell a quantity of potatoes, when both the farmer and his horse might be most advantageously employed at home in the business of the farm, and

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* There is a very general complaint against turnips, that they give a bad taste to the butter—but this is not necessarily the case.

The fact is ,turnipmilk will not keep as long as grass milk, but gets rancid; and this is increased by the practice of keeping the churn near the fire in winter, which is sometimes done. The milk, on the contrary, should be kept cool, and warmed when churning by as much boiling water as it will bear. When yellow turnips are used, the butter will be, nevertheless, a good colour; but if wanted with more of a yellow shade, dairy-maids use grated carrot in a cloth, wet with boiling water, and squeeze it into the churn. As the milk does not keep, it is of great importance to churn often, at least twice, and if possible, three times a week, so that it cannot be let stand for cream, but churned whole. Where so frequent churning is impossible, it is but to add one-eighth part of boiling water to the milk as it comes from the cow, and cover it over with a double cloth, which prevents the heat escaping, and imbibes the steam which seems to carry off with it the peculiar flavour which the turnip would otherwise communicate—but under any management much will always depend on the cleanliness and attention of the dairy-maid.

† Richard Lloyd, Esq. states as follows in a Treatise on Agriculture lately published by him :—The early Dutch garden turnips is by no means an unprofitable root; my breadth of land in vetches last year being very limited, I reserved them all for my horses. In consequence I sowed half an acre of the

early Dutch in March; I commenced taking them up in July, and, first steaming them, served them without any other food to eighteen newly weaned pigs, and also to three breeding sows and a boar: they lasted until the end of October, when my other turnips were ready to supply their place. On the 23d of the following November I sold the eighteen pigs as stores for £23, which had consumed very little more than the produce of half an acre, and left behind them several cart-loads of very rich manure. Their condition as stores was remarkably good, and they were never out of confinement until they went to the fair: the price on pigs at that time was high, but had it been considerably lower they would have paid well. I have mentioned this circumstance as a substitute for vetches, and it is well worth any man's consideration and adoption. I should recommend vetches in preference, there being much less trouble attending them; but to have a certain quantity of both would be most advisable. This year my pigs will have no other food than vetches as long as they last. It may be observed here, that if a farmer is very desirous of trying two crops in one year, he could not adopt a better or surer plan, than by sowing the early Dutch turnip in March, and early in July, putting in spring vetches after them, the vetches would be consumed in October, and wheat might succeed them, but the land must be of good quality and the turnips well manured for.

that, in the former case, he gets his money *in a lump*, whereas the potato-seller receives payment in small sums, which, perhaps, may be frittered away before it accumulates to any amount.*

It should also not be overlooked, that even if only half the potatoes were planted which the family might require, in order to make room for such crops as would produce food for one or more cows, the value of the milk which would be thus obtained would buy more than twice the quantity of potatoes which the ground taken would have produced; and where there was little land, it might be very profitable farming to plant only early potatoes where there was a *good market at hand*, to sell the whole off in the end of July, and sow the land with rape and Malta turnips, for winter and spring feeding. The value of an early crop of potatoes is very often superior to a late one, and the owner would have the money to lay in his supply in November, and would have, besides, all the winter and spring feeding, and the milk and manure which the after crop would yield. A judicious farmer should not consider himself bound to raise the potatoes he will consume himself on his own farm. His object ought to be to manage his land in such a way as to produce him *most money*, which will always supply him with what he may want.

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* The force of these arguments appear to me still stronger now than when originally written, for the experience of 1835 has shown that the wheat produced has so far exceeded the demand, that the price fell so low as to make it a losing crop to the farmer; although formerly it was that upon which he most relied to make up his rent. This was so generally the case, that the land was turned to the growth of oats and barley to such an extent that, with the aid of but an indifferent harvest, the quantity of wheat has been so reduced as to restore the price to a remunerating rate, but I have no doubt that from the improvement of agriculture, more grain of all kinds will be raised in average seasons than there will be found consumption for at profitable prices. If this be a true view of the case, it is quite evident that you should turn your chief attention to cattle crops. It appears clear in ordinary cases we can do without any importation of foreign grain, but we have never yet been able to do without an importation of foreign butter, which, on the contrary, has been annually increasing. This shows what is most wanted, and what is most wanted will always pay him best who has it to sell; and accordingly, you will find on calculation, that an acre of clover and rye-grass, if applied to house feeding, will yield you, upon an average, a larger return in the value of the milk and butter it will give, than any average produce from grain, the gain upon which latter I fear will yearly become less until the quantity at market shall be reduced by turning a larger portion of the soil to flax, hemp, butter, fallow, &c. which might easily be done by the legislature giving those crops the same protection as grain now enjoys.

Acting upon *this* principle, it appears to me, the man who cultivates green crops largely, and is able to buy extra stock when wanted to consume them, will make more of his farm than in any other way. For example, suppose an acre of rape put in after winter bere or spring vetches, the land to be well manured and the plants dibbled in by the second week in August, it will be ready to cut to great advantage when the clover fails in the middle of October, and would enable the owner to pay himself well by vealing calves, after which it will be ready to cut again in April following, and will feed ten to fifteen head of cattle for a month or five weeks;* and supposing that springers have been laid in in low condition to calve about the first week in May, they will by that time be so much improved, and being also just ready to calve, they will sell at an advance of 25s. to 30s. each. But to take every thing at the lowest, say eight cows sold at 25s. profit, amounts to £10, leaving the ground and the manure ready for turnips, an acre of which will fatten four head of ordinary sized cattle, which should yield a profit of £3 to £4 per head, but calculated at 50s. will produce £10 more; that is £20 gained by the acre, without calculating any thing on the October cutting, which is worth £5 an acre more, leaving the land in good heart for sowing barley and clover; or he might put in spring vetches, and after feeding them off in the same way, prepare the ground for wheat. Now, after making the largest allowance for seed and labour, and some hay for the cattle when fattening, the manure being supposed to pay for the straw, it is evident there will be more clear profit remaining than any single crop would produce; and, of course, if a man has money to deal in this way, it will be his interest to do so, and with the money so gained buy the potatoes or other produce he may require. I have selected as an instance, a crop of rape to begin with, as it comes in earliest, and cattle generally give a larger profit laid in about the end of March or beginning of April, than at any other season. Mr. William Dougan of Lisdrumcher, has followed this plan this last season, and has realized a much larger profit; but at all seasons, springers bought in poor, and well fed for a month or five weeks, and sold when ready to calve, are sure to leave a handsome profit, perhaps more than vealing calves, as recommended in October. But the benefit of having a large supply of rape, Swedish turnips,* or mangel wurzel for spring, is also of great advantage where there are large grazing farms, as it enables the stock to be kept in the straw yard until the grass rises, which, by the shelter it affords, draws up a succession of young shoots, and produces a growth of grass that cannot be eaten down by the stock, which would have been half starved upon the same ground if they had been more early turned out upon it. Some of you, however, may perhaps say, as I have often heard it urged, that your land would not bear this constant turning and ploughing for so many crops in succession. But there seems to be a great mistake in this opinion. If repeated ploughing was to do the land so much injury, how does it happen that it produces such crops after a fallow, when it has been ploughed perhaps five times, with scarcely any intermission. The truth is, that it is not the constant *ploughing* but it is the constant grain crops you put in when you do *plough*, that does the harm,† and you need have no fear whatever about hurting your land in that respect,* if you only pursue the proper rotation of crops, taking care to introduce vetches and clover between your grain crops, which refreshes the land more *in one year* than lying out to rest in a poor state would do in three or four, as I have already said.

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* The cutting in October prevents the crop in April being so heavy as it otherwise would be, or it would do more than this, if let come into blossom without previous cutting.

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* It is a singular distinction between the Swedish turnip and all others, that it seems to suffer very little in the quality of the root by being allowed to stay in the ground and shoot up to seed, which gives a cutting like rape, and yet the root will afterwards remain sound and sappy, and fit for cattle feeding until the end of June. When this plan is pursued the ground should be afterwards sown with late spring vetches, to cut in October or November.

† It seems to me that the increased fertility of fallowed land is mainly attributable to that very turning which is sometimes complained of as an evil. By this, every part of the soil is exposed to the action of the atmosphere, the effects of which in promoting fertility may be estimated by observing the barrenness which follows from excluding its influence. Examine the *ground under* the *back* of one of the newly levelled ditches, or what is called the seat of the ditch: now, when the ditch was originally made, this was the surface productive soil, and the stuff thrown out of the gripe to form the back was perfectly barren till. But now you will find the case exactly reversed, what was then the fruitful surface soil is now rendered barren by being excluded, by the back of the ditch heaped over it, from *the action of the atmosphere*, and the back, which was then barren, is now rendered fruitful *by being exposed to it.*

But others will be ready to complain of the great labour it will require to put in one crop after another in this way; and no doubt more labour will be required in this mode of cultivation than if you kept half your farm constantly lying at rest; but is not the want of employment your constant complaint, and if the crop pays you, are you not better off working for yourselves on your own farms, than working for Lord Gosford or Colonel Close, into whose employment it seems to be such an object to gain admittance. That the extra crops you will in that case find yourselves possessed of will amply repay you for the extra labour you bestow on them, you need not doubt. Look to the case of James M'Donnell of Ballindaragh who was one of the daily labourers at Gosford, whose farm was in such a neglected state that I directed his Lordship's steward to discharge him, and send him home to work for himself. It is now two years since, and at that time he was in the greatest poverty, without a four-footed animal in his possession. He thought he was turned to beggary when he was dismissed; but go to his place now, and you will find him with a couple of cows, and one or two pigs, and every thing in a thriving state about him. It appears, therefore, his own farm paid him much better for his labour than he was paid for it at Gosford; and every one who has land to work upon will find in like manner that he can earn more at home by raising extra crops thereon than all he can make by his working elsewhere. This last objection, therefore, should rather be considered an argument in favour of the plan proposed, than be given as an argument against it.

I have thought it necessary to go into these particulars, because there are always people to be found ready to start objections to every thing which differs in any respect from what they have been accustomed to; but to any one who takes the trouble seriously to consider the matter, the gain that may be made in the way I have just pointed out will be very evident; and the only real objection I can see to its being more commonly acted on is this, that it requires more *capital* to lay in the extra stock required than I fear you are in general at present possessed of, *the want of which* will therefore oblige you to leave the profit to be made by dealing in cattle, in the manner I have been speaking of, *to others*, and to limit your own operations to the purchase and maintenance of the permanent stock suited to your holdings, which, as I have elsewhere said, should *never be less* than one cow to every three acres of arable land; and when you have once attained to such a degree of prosperity as to be possessed of that stock, be assured there is nothing wanting but industry and sobriety to insure your future comfort and independence, and also such a gradual accumulation of property* as will enable you to provide for your children without applying to the miserable resource of dividing your farm (already perhaps too small) among them, thereby making paupers of your entire family; and let no one be discouraged from commencing to raise green crops, if he has the means of doing so, by the consideration that he has not a cow to get the benefit of them. Supposing he is so poor as not to be able to buy a cow, still there are few people who have their health, and are inclined to be industrious, who cannot raise the price of one, two, or three young pigs, in which these crops will in a little time produce such an improvement, that, in the common course of things, before many months he will be enabled to purchase the cow he was in want of; and would, most likely, not have been able to get in any other way. Vetches, clover, and cabbage, are excellent feeding for growing pigs, and would soon augment their value to the amount required; and if this plan of getting a cow should fail, he will seldom be disappointed (whilst the system of farming now in practice continues) in getting the use of a cow, for her keep, from those who have not sufficient food for their stock, by which arrangement he will have milk for his family and manure for his farm.

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* So little cause is there to apprehend any impoverishment of the land, that I find on several farms this last year they have lost their clover by the luxuriance of their oat crop, and they will have to change to barley.

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* I do not know any considerable estate in the North of Ireland, in which the tenant will not be able to pay his rent by milk and butter, provided he house-feeds this amount of stock, thereby leaving to him his pigs, his poultry, and all his grain entirely to himself, which shows the practicability of the accumulation here spoken of in all ordinary cases.

CHAPTER VI.

CASE OF SMALL FARMERS IN REDUCED CIRCUMSTANCES—MODE OF RECOVERY POINTED OUT—CROPS ACCORDING TO OLD METHOD COMPARED WITH THOSE RECOMMENDED—OTHERS TO BE SUBSTITUTED ACCORDING TO CIRCUMSTANCES—IMPROVEMENT IN THE POWER OF ALL—OBJECTIONS ANSWERED.

BUT it is seldom that any one deserving the appellation of even a small farmer, is so very low in the world as not to have a cow of some sort; and the more common case is, that he is possessed of one at least of those useful animals. Let us suppose him, then, to have four acres of land and one cow, and that two acres are in grazing, or put out to rest, as it is termed; and of the remainder, half an acre is intended for potatoes, half an acre for first crop of oats on last year's potato ground, half an acre of second crop oats, and the remaining half acre third crop oats; which altogether make up the four acres; and, with a small garden, may not be considered to be an unfair representation of the general circumstances of the poorer class of small farmers. Now, if an industrious man, reduced to such a situation by bad health, or any other calamity, without capital, and without friends, was to ask me how he, as a small farmer, might contrive to extricate himself from his difficulties and retrieve his affairs—(and this is a question which, above all others, most vitally concerns the poor of Ireland)—I should answer by saying, if a small farmer means to live by his land, his first object ought to be to make every inch of that land as productive as its nature will admit of—and this can only be accomplished, (as I have stated in the commencement,) by having plenty of manure, and pursuing such a rotation of crops as shall prevent the ground from being ever exhausted. Various methods may be taken by him to arrive at this, according to his particular resources and the circumstances of his farm; but, under any state of things, he must keep in mind the fixed maxims of farming already enumerated. By reference to these, he will, in the first place, see that wherever he intends to put out his manure, the land should previously be effectually drained; and likewise that the weeds should, as far as possible, be eradicated before putting in his crop. If these directions are not attended to, a cold wet subsoil will destroy more than half the strength of the manure, and half the remainder will perhaps go to nourish the weeds, in place of the crop he intended it for. The next thing he will see pointed out is to provide for the increase of his manure, by preparing the means of feeding his cow in the house, and to refresh his land by a change of crop. It is from want of attention to these points, the returns from his farm have been heretofore so much reduced, that he has been kept struggling in poverty, when, with *less* labour and *more* skill, he might have been living comfortably. But as an example will make every thing more intelligible, I should be inclined to recommend him, as one mode of carrying the rules laid down into practice, (draining and clearing his land being always attended to in the first instance,) to sow clover and grass-seed with his first grain crop, as a provision for house-feeding his cow the *following year;* and he must begin early and put in kail or cabbage into his potato ridges, and sow a succession of vetches on the stubble of his last year's potato land oats, to serve as feeding for the present. If there should be any overplus after feeding his cow, and that he should not be able to buy pigs to consume it, he may let such part stand for seed, the produce of which will generally be more valuable than any second crop of oats, and the straw from it will be found much superior to oat straw, as fodder, and contribute to the support of his cow in winter. He will further observe, by the fourth rule, that the manure for his green crops, such as potatoes, turnips, &c., should be put out upon that part which has been exhausted by grain, therefore let it be given to the stubble of last year's second and third crop of oats; and by attending to the fifth, sixth, and seventh rules, let him take care not to have any of his land or manure wasted; and, by burning the backs of the old ditches desired to be levelled, he will obtain such a quantity of ashes as will enable him, with his other manure, to sow half an acre of turnips and an entire acre of potatoes, in place of the half acre, as formerly supposed. By this means, he will be able to bring in half an acre of the poorest part of the grazing, the remaining one and a half acres of which may be used for the support of his cow, until the vetches become fit for cutting, when, if he has any ashes remaining, or as far as the summer manure will cover, the grazing may be broken up and prepared for rape. Supposing these matters to have been conducted upon this plan, when the turnips become ready for use, it will be practicable for him to fatten his cow, and sell her for a price that will enable him to make up the price of two lean ones, or at least to add a heifer to his stock. One rood of turnips is calculated to fatten a cow of moderate size, that has been well fed in summer, which his would have been on the vetches; therefore, he would have remaining still one rood of turnips, the curled kail, and what rape he might have got sown, to enable him to support the two cows thus supposed to be bought for the remainder of the year, until the clover would be fit for use, which was formerly directed to be sown.

In considering the foregoing, I do not see any extra outlay which can be said to render this commencement impracticable, nor any reason to suppose that the person's means of paying his rent will be in any manner curtailed; on the contrary, it appears to me that, besides the additional half acre of potatoes, the vetches substituted for the second crop of oats will produce, by the superior keep of the cow, in milk and butter, and rearing of pigs, more than double what an inferior crop of oats would be worth, and that by these articles alone, the entire rent of a four acre farm would, in common years, be paid, leaving the profit of the remainder of the farm to go entirely to the support of the family and the increase of the stock. But if it is clear from this statement that the farmer's circumstances the first year will not be *made worse*, it is still more clear that the second year they *must be made better*; for it is plain he will then have more than double his former quantity of manure (owing to the turnip feeding and the second cow) which, with the ashes of his remaining old ditches, will be fully sufficient to bring into cultivation all the remainder of the grazing land lying out to rest, which will now be made to yield him a valuable crop of potatoes and turnips, and he will have the unmanured land of last season, amounting to one and a half acres in place of half an acre, as formerly; besides all which, he will have as good a crop after the vetches as after his potatoes, and thus there will be no part whatever of the entire farm which will not be under profitable crop; and the clover, with what vetches he may think it necessary to sow, will supply him with the means of feeding his two cows in the house, by continuing which practice, he will have sufficient manure to keep his land constantly in good heart, and enable him to follow for the future any rotation of crops he may think proper.

In order to make what I have said more intelligible, I put the statement into figures, viz:—

SUPPOSED CASE OF A FOUR ACRE FARM.

Field No.		A.	R.	P.
1	In Potatoes (having only one cow, and not fed in the house), he will not be able to manure more than - - - -	0	2	0
2	In oats, upon last year's potato land - - - - -	0	2	0
3	In oats, being the second crop after potatoes - - -	0	2	0
4	In oats, being the third crop after ditto - - - - -	0	2	0
5 6 7 8	In grazing, lying out to rest - - -	2	0	0
	Entire Farm - Acres	4	0	0

PROPOSED CROP TO BEGIN AN IMPROVED SYSTEM.

Field No.		A.	R.	P.
1	To be sowed in Wheat or Oats, being last season's potato ground, and laid down with Clover and Grass - - - -	0	2	0
2	To be sowed in Vetches, after first crop of Oats - - -	0	2	0
3	To be sowed in Turnips of different kinds - - - -	0	2	0
4 5	To be planted in Potatoes,* supposed - - - -	1	0	0
6 7 8	Best part of the Grazing to remain for one cow, with Vetches	1	2	0
	Acres	4	0	0

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* I calculate the extra manure wanted to be acquired by burning the useless ditches: where the manure has been formerly so small, the fields must be small size, and the ditches more numerous of course.

SECOND YEAR OF IMPROVED SYSTEM.

Field No.		A.	R.	P.
1	In Clover fit for cutting	0	2	0
2	In Oats (after Vetches) if a second cow has been got, one-half Vetches may be necessary, unless cabbage and Kail are cultivated	0	2	0
3	In Barley (after Turnips) laid down with Clover and Grass-seed.	0	2	0
4	In Wheat (after Potatoes) supposed planted on house manure, laid down with clover	0	2	0
5	In Oats (after Potatoes)	0	2	0
6	In Turnips, having been trenched up before the frost	0	2	0
7 8	In Potatoes	1	0	0
	Acres	4	0	0

The ditches of Nos. 7 and 8, burned, and the produce of two cows fed in the house for most part of the year, will give the requisite manure; and on a comparison of the crops and the keep of two cows, the return appears to be four-fold the value of what it was, with the certainty of the land every year getting better.*

I think any one who will afford a few minutes' consideration to the foregoing, will be of opinion that a satisfactory answer has been given to the question proposed, and that by a simple reference to the maxims laid down, a mode of recovery has been pointed out, which cannot fail to accomplish its object, having for its foundation, principles which may be successfully applied to the circumstances of every such farm as the case supposed; and a more important case cannot well be submitted to the consideration of the friends of Ireland, in its present situation. The plan recommended has been selected as affording a clear and concise exemplification of the operation of the principles laid down, but it is not meant to be a prescribed course that every one should invariably follow; on the contrary, it may be changed and modified, in a variety of ways, according to the nature of the farm, which may call for the introduction of other crops. Thus cabbage, field peas, and beans, mangel wurzel, and many other things which I have not taken into account, may, in many cases, be found more desirable than those I have adopted. Where manure is scarce, kail, and thousand-headed cabbage are particularly valuable; they will grow with great luxuriance upon the back of a new made ditch, without manure of any kind, which proves that nothing more is required to insure a crop than to turn up new earth, by deeply trenching the ground before the frost sets in. Curled kail should be sown last week in July, or first week in August, and planted out as early in March as any soft weather takes place; thousand-headed cabbage should be sown in March, and planted out in June or July, as soon as the plants are sufficiently grown; both will give a plentiful crop of leaves at November, and also the following spring, besides giving a large after cutting, in the manner of rape, when shooting up to go to seed: but in whatever way the object is accomplished, still the principle of house-feeding, and a rotation of crops must be equally attended to. I am fully aware that a person whose resources enable him to buy lime or other manure, may at once succeed in making his entire farm productive, without waiting for the slower process which, to his poorer neighbour, may be quite indispensable; but the person with such resources, although he may hold a small farm, does not fairly belong to the class of those by whom the question was supposed to be put, and he answer therefore seems properly restricted to the single object of showing all those to whom it was addressed, that they might get on by their own industry, without any outlay beyond the means they may be fairly supposed to possess, and that if they do not better their situation, it is not by reason of its being out of their power so to do: such being the case, persons so circumstanced, I trust, will not shut their eyes to what is so plainly for their advantage to see. If their farms should be somewhat larger than the case stated, it may perhaps take a little longer time to bring them round, but still the improvement will be progressive, and they will be encouraged as they proceed, by seeing that every step is not only attended with its own peculiar advantages, but likewise facilitates that which is to follow; and I therefore cannot but hope, that any among you whose cases may resemble that which has been stated, may be induced to take what has been said into their most serious consideration, and to try the effect of the proposed change in their system of cultivation, notwithstanding the obstacles which may be started by those who are too indolent to exert themselves, or so much prejudiced in favour of old habits, as to think they cannot be improved. Such people, among other objections, will perhaps say, if we follow this plan, according as the manure increases, our grazing will be broke up, which is always a sure provision for our cows, and then, if the clover and turnips fail, what is to become of us? The answer to which is, that there is little reason to apprehend any failure in the clover crop, if the land is properly prepared, in which a person well qualified, will be appointed to instruct you; but if from bad seed, or any other cause, a failure should take place; it will not affect the rye-grass sown with it, which may be cut as soil; and as any such failure will be evident by the month of September, there will be full time to put in winter vetches, annual clover, and early cabbage, to supply its place, and be ready for use before the rye-grass is consumed, and the succession of cabbages may be kept up until the succeeding crop of turnips is fully ripe, or spring vetches may be cultivated to any extent.* In the mean time, the land upon which the clover is supposed to have failed, is by no means lost; the rye-grass will be cut in ample time to dig up the ground and put it into turnips. It appears, therefore, there would be little cause for apprehension, even if such a failure did take place, and there is still less danger in regard to turnips, the different kinds of which may be sowed from the middle of May (when the Swedish turnip is sown) to the end of July, at which late period the Malta turnip will yield a full crop; so that if one sowing was to fail, it may be supplied by another of a different kind. Some inconvenience may however be felt, in case a failure should take place in a crop of Swedes, as they are relied upon for the latter part of the season; but this also may be guarded against by sowing a sufficient quantity of rape to succeed the yellow Aberdeen, and yield food for the stock until the succeeding clover and rye-grass are ready for use. Others will tell you that it is an unnatural thing to confine cows to the house or straw-yard, and that they will give much more milk upon grass; and this is very true in *summer*, if the grass is good; the reverse, however, is the fact, even *then*, if the comparison is made, with such grazing as the small farmer's cow is usually turned out upon; but in *winter*, a cow well fed and kept warm in the house, will give twice, or perhaps three times as much milk as what she will when turned out and exposed to cold and hunger and wet, upon the bare hills, I often see them on; and at that season of the year materially injuring the land by poaching it with their feet, whilst wandering over it in search of food; besides all which, it is to be taken into the argument that the manure* will be saved, and that where a poor man now keeps *one* cow, he would, upon the plan of house-feeding, be able easily to keep *three*.†

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* Simple as this rotation may appear to any educated person, I am quite sure very few countrymen would be able to act upon it from merely seeing it stated on paper. I therefore add, as an instruction that cannot well be mistaken, the advice that all their manured land shall be laid down with clover and grass seed, with *first* grain crop, or reserved for vetches the following year; and to persist in this and the growth of turnips, until they can keep their stock in the house; after which, if they have any useless pasture remaining, let it be ploughed up and summer-fallowed, so as to prepare it for crop the following season, such as it may be fit for; and if too poor for grain, and manure be still scarce, the cultivation of vetches will soon bring it round to a profitable state.

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* The Italian rye-grass lately introduced, seems by its rapid growth, well qualified to make up for all deficiencies of this kind.—(See Appendix.)

All these objections, when they come to be considered, are easily confuted; indeed the people who make them, do it more as a cloak to cover their own slothfulness, than from any belief in the truth of what they advance; for the case is so plain, and the benefit arising from feeding the cattle in the house, and having such an abundance of manure as to render the whole farm as rich as a garden, is so apparent, that no one can avoid being sensible of it.

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* Mr. Cobbett estimates the quantity of manure which may be accumulated by the owner of one cow fed in the house, to be sufficient to manure one acre; and in these calculations he is not bad authority; but I only calculate on its manuring three roods.

† Cattle fed upon Clover, either in the field or in the house (when it is given too soon after being cut) are liable to its fermenting in their stomach, which if not observed in time, will occasion their death. The usual remedy is to stab them in the side, in order to let the air escape: but this is no small injury to the animal, and the cure may be effected by putting down the throat an egg-shell full of tar, in which three or four drops of the spirits of turpentine has been mixed. Cattle getting too many raw potatoes are liable to the same complaint. Some garlic pounded and made into a ball with a little oat-meal and water will give relief in a very short time also, and no countryman's garden ought to be without some garlic, were it only for this purpose.

CONCLUSION.

PRESSING THE IMPORTANCE OF THE SUBJECT, AND EXPLAINING THE PLAN OF ASSISTANCE TO BE GIVEN—ADVANTAGE OF PLANTING TIMBER FOR FUEL—PRESENT STATE OF THE SMALL FARMER, AND THE APPEARANCE OF THE COUNTRY, CONTRASTED WITH WHAT THEY MIGHT BE—ANXIOUS DESIRE THAT THIS ADDRESS MAY BE ATTENDED WITH SOME GOOD EFFECTS.

THERE are nevertheless many well-meaning people such slaves to habit, and so little able to form a just estimate of what their own industry and exertion would enable them to accomplish, that they despair of surmounting the difficulties which surround them; and it has often fallen to my lot to be told, with a perversity of reasoning not a litttle provoking, "that such a plan might do very well for the rich, but how could any poor man *afford* to farm his land in that way?" and, notwithstanding, it is evident the poor man can least of all *afford* to lose any gain which might be made by following a better system. He seldom thinks of making even an attempt at what appears to him so far beyond his utmost efforts; whereas, if the attempt were made, scarcely any industrious man could fail of success. From a sincere desire to benefit all of you, but particularly those of this unfortunate class, who, under existing circumstances, seem likely to be deprived of their small holdings, if they do not hit upon some expedient so to better their condition, as to be no longer a disgrace to the properties they inhabit, I have endeavoured, in the foregoing Address, (as being the first step to improvement,) to convince you of the wretched plan you have been hitherto pursuing, and of the beneficial change which might soon be brought about by adopting some such alterations as I have been suggesting. In this I hope I have at least so far succeeded, as in some degree to weaken your attachments to old customs, and dispose you to follow such instructions as may be given to you; and in order to set aside any excuses that might be made, either on account of ignorance or inability, I have, with the concurrence of your landlords, engaged two Scotch farmers or agriculturists, for the purpose of giving the instructions you so much require. You will find them to be practical men, who have had experience of every kind of soil, and know how each should be treated. After minutely examining your different farms, they will point out to you how they are to be drained, cleaned, and prepared for the growth of green crops, so as to introduce the plan of house-feeding and accumulating of manure, which has been already insisted on. Thus your want of skill in the management of your land will at once be remedied; and then, to provide you with manure, (the want of which at present I am aware would incapacitate you from cultivating the crops recommended,) your landlords have kindly consented to lend such of you as may require assistance as much lime as will be sufficient to insure you as many potatoes as you may require for your families; on condition that the house manure you may be possessed of shall go to the other crops which the agriculturist may point out. Thus nothing will be wanting to the perfect cultivation of your farms but your own industry and that of your families; for the above-mentioned assistance will be continued to all such as show themselves deserving of it, until they are brought into a situation no longer to require it. My employers, therefore I repeat, having gone to such expense and trouble to better the condition of the small farmers on their estates, and the benefit to be derived by following some better plan of cultivation being so evident to the commonest understanding, no one who, by his own want of industry, fails to take advantage of the assistance offered, can have just grounds of complaint, if the land which he refuses to cultivate, is taken from him, and given to some of his more industrious neighbours, which will most assuredly be the case, when a fair time for making the experiment has been allowed.*

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* He who leaves his land uncultivated, and not producing one half of what it ought to do, may not unaptly be addressed like the unfruitful tree in the parable—"Why cumber ye the ground?" And having met with reasonable care and indulgence, may with equal justice, like it, be no longer left in possession of the soil.

I trust few will be found so blind to their own interests as to force their landlords to this painful alternative; and it is with great pleasure I look forward to the prospect of seeing their estates peopled with a thriving tenantry, and covered with neat and respectable cottages, and the farms divided by hedge-rows of useful and ornamental timber, with underwood for fuel. The *cattle being kept from injuring these plantations* they would soon come to a luxuriant growth, and I am confident would not only yield a quantity of valuable timber, but also sufficient faggots to afford a cheerful fire in the winter's evening; and if the farmer has a lease, and registers the trees planted, as here recommended, he may have, at the expiration of his tenure, even if the farm be a very small one, one hundred or two hundred trees, from twenty to forty years old according to the duration of his lease, *well grown*, which they will be, if the cattle are home fed, and thus prevented from injuring them; and these trees he cannot be prevented from selling at their full value; and if his landlord even should turn him out, (which in such a case is not likely,) he would not have to go away empty handed; and thus the *bank* of his ditch would be to him a *savings' bank*, the most economical and the most productive he could have recourse to.

When the present state of the small farmer is considered—reduced as he often is, to potatoes and salt, and perhaps even a scanty supply of these, with a house almost unfit for a human habitation, and suffering under a scarcity of both fire and clothing; and then look forward to him in the enjoyment of the comforts of life, well fed, well clothed, and well lodged, with a cheerful fire on the hearth, and his flitch of bacon in the chimney—what a change is opened to the view, and what an ardent wish arises to see it realized! Again, when the beautiful variety of surface, which this country affords, is now observed bleak, dreary, and naked; and then look forward to it covered with well built cottages, well laid out farms and thriving plantations, with contentment and its natural companions, good order, peace, and prosperity reigning around, surely every one ought to be tempted to put his hand to the work, and as far as his influence extends, assist in bringing about a change so desirable. Connected as I have been with you now for many years, I feel most sincerely desirous to give effect to the kind wishes of your landlords, and to use the means placed at my disposal, and the influence my situation as land agent gives me, to promote your comfort and happiness. It is that feeling alone which has prompted me to take the trouble of thus addressing you, and to devote so much time to personally enforcing the requisite attention to the instructions of the agriculturists who are engaged for the purpose of directing you in the selection of the crops best adapted to the soil and situation of your farms, and the proper mode of cultivating them. Their appointment renders it unnecessary for me to enter into any discussion upon those subjects.* which would require more space than would be suitable to this Address, already prolonged much beyond my original intention. All I contend for is, that you shall cultivate such a succession of crops as will afford a plentiful supply of moist food for your cattle in the house, during the entire year. Experience has fully proved that one-fourth of the land usually employed in this way will suffice: and as home feeding has the additional recommendation of producing the manure necessary to bring the land so saved into profitable cultivation, common sense will justify me in *insisting* upon the practice being adopted, which, under the orders of your landlords, I am determined to do. I have only further to add, if my exertions should in any manner bring about that improvement which is so much required in the cultivation of the soil upon which your welfare and happiness so much depends, I shall feel myself most amply rewarded. But if the perusal of the foregoing should have no other effect than merely to awaken your understandings to the consideration of the subject, and induce you to think how every thing may be turned to the best advantage, and how you may make the most of every opportunity which may offer to better your situation and increase your comforts; I shall even then congratulate myself that an important service has been rendered to you and your families, by your sincere friend and well-wisher,

WILLIAM BLACKER.

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* In this respect, I would beg to refer to Mr. Martin Doyle's "Hints to small Farmers," which give most valuable information, not only regarding the cultivation, but also as to the respective merits of the different crops at present cultivated in this country.

P. S.—As nothing which tends to increase your comforts in any way is foreign to the nature of this Address, I cannot help calling your attention to the high price you often give for oatmeal, when wheaten meal might perhaps yield a much cheaper and more nourishing food. If you buy wheat and get it ground at any common country mill, your hundred weight of wheaten meal will not stand you generally more, if so much, as a hundred weight of oaten meal. Now, if you take and mix a well beaten up egg with a pound of the wheaten meal, and wet it with milk made boiling hot, it will produce near a pound and a half of excellent bread, which, by being warmed before the fire, will be as good the second and third day as the first, and will contain nearly twice the nourishment which a pound of oatmeal will yield. It also surprises me that *in winter*, when milk is scarce, you do not try to make a substitute of broth. A single ox head, which you may buy in any market town for a shilling, with a small quantity of groats or barley, and a few onions, cabbage sprouts, sliced turnips, or any thing of that kind, will, I am informed, make twenty quarts of broth of most excellent quality; and again, in summer, when potatoes get soft and bad, if the skin is taken off, and they are put into a pot to stew, with about three pints of water to a stone, and half a pound of bacon, cut into very small pieces, put at the top, with a little pepper, salt and onions, and the pot kept close covered, it will make a wholesome and palatable mess for an entire family. Any one wishing to get more particular information on this subject, may easily find persons able and willing to give it; and what tends to the comfort and satisfaction of a family two or three times every day of their lives, is surely well worth being attended to. Almost all of you know what a good mixture beans and potatoes make, and what nourishing food it affords; and yet how seldom do you see raised the small quantity of beans which will be required for this purpose.

APPENDIX.

No. I.

Useful Hints for the Labourer, published by the Labourers' Friend Society.

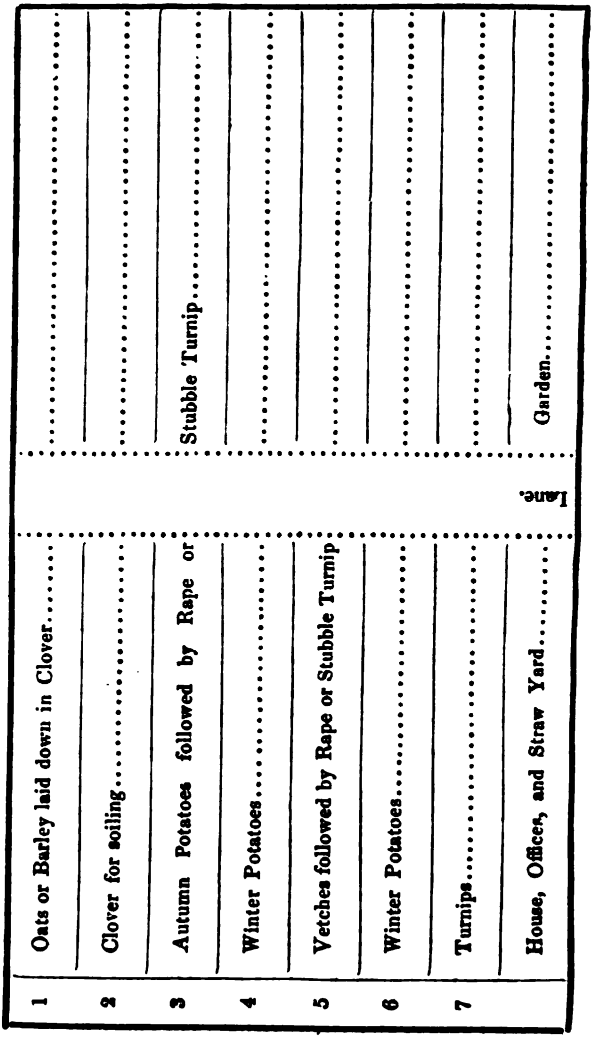
> "He that tilleth his land shall have plenty of bread: but he that followeth after vain persons shall have poverty enough."—*Proverbs* xxviii. 19.

Savings' Banks.—Should a young man of 18 begin to save 2*s.* a week, and go on regularly for ten years, he would at the age of 28 have in bank, reckoning his savings and the interest, about 60*l.*; the value of which, observe, consists very much in the manner of acquiring it. For suppose him to have spent those ten years, as is too commonly the case, working half his time, and drinking and idling the rest, and suppose the sum of 60*l.* to be then given him, what effect would it have? Would he not most likely drink more and work less? But when a man has set his mind upon saving, he will almost necessarily contract such habits as will make his savings useful. He will find hard work grow easier, because it increases his gains; he will shun idleness, because it stops them; he will turn away from the ale-house, because it swallows them up; he will be content with frugal fare, because it adds to his savings and though he may look forward to the comforts of marriage, he will be in no hurry to bring upon himself the charge of a family. Being careful himself, he will look about for some careful young woman, and they will resolve not to be married till they can furnish a house, and have some money in store. This will make them doubly industrious and doubly careful, and then their savings will mount up so fast, that, perhaps, they will begin to have higher notions, and will put off their marriage a little longer, till they have saved enough to set up on a small farm, or in some business, where they think they can, by joining their savings, become richer, though married, than they could if separate. Here marriage is indeed a blessing! The children will have advantages in education which their parents did not possess; and though all this cannot happen to all, it is yet impossible to foresee what benefit may arise to a man and his descendants, from placing a portion of his early earnings in a savings' bank. One shilling a week saved, will, with the interest, amount to 20*l.* in seven years; three shillings a week will amount to 60*l.* in the same period. If a man who earns 30*s.* a week deposits 10*s.*, he will possess, at the end of five years, 140*l.*; and if he should marry a female who has been able to accumulate half as much, they would together possess no less a sum than 200*l.* to begin the world with. It is true that a savings' bank holds out the best prospect to those who are young and unencumbered, but almost all may derive some advantage from it; at least they may point out to their children the easy means of securing their own comfort, and it will be strange if, out of a large family, some do not prove able to assist their less fortunate parents in their old age. Teach but a child to put part of his first little earnings in the bank, and, in all probability, poverty will not overtake him to the end of his life. Teach one child to save, and others will follow the example, till industry and frugality become as common as vice and misery are now. If a boy of 12 years of age can lay by 3*d.* a week till he is 14, then 6*d.* a week till he is 16, and then 1*s.* a week till he is 18, by which time he may be be supposed to have learned his business, he will have in the bank, adding the interest of his money, 10*l.*, besides having acquired habits of industry and carefulness. It has been shown above what he may lay by in the next ten years; and what he will be at the end of that time, compared with men of his own age who have not saved, and who are neither industrious nor careful, need not be shown. Many who have been wild in their youth begin to be steady when they marry; but bad habits will break out, and an increasing family presses so hard upon these who have nothing beforehand, that they often become discouraged, and sink under the evils of poverty. They need not, however, despair. Let them consider if they have not some inclination which they now and then indulge at the expense of some of their comforts, though the thought of it afterwards only causes them pain; let them try to turn that inclination into an inclination for saving; it will soon grow upon them, for it gives pleasure both in deed and in thought; it will go with them to the plough, it will stay with them at the loom, and it will sweeten the labour of both. Let them only make a beginning, if it is but with sixpence; if necessity compels them, they can take it back; the attempt will do them credit, and perhaps they will be more fortunate another time. Let them consider every penny they spend; let them examine if they cannot do without something which before they thought necessary. If they happen to have money in their pockets, without any immediate use for it, let them take it to the bank, and trust to their industry to supply their future wants. A shilling, not called for, soon tempts to the ale-house; it is soon spent there, a shot is soon run up, a day's wages are soon lost, and thus 5*s*. are gone without thought and without profit. Now, 5*s*. in the bank would make an excellent beginning towards rent, or towards clothing. Scrape a little money together, and some pounds in the year may be saved by laying in potatoes, or coals, or flour, at the best hand, instead of in very small quantities, and on credit. By buying two pair of good strong shoes at once, so that they may be always well dried before they are put on, and mended as soon as they want it, two pair will last as long as three that are constantly worn. Here are at least 10*s*. saved, besides the saving of health and strength. There are many other ways of saving, by means of a little money beforehand; and it is clear that a man and his family, who earn even moderate wages, may, by good management, live better than they did before; or, if they prefer it, may lay by something at the end of the year. If a man wants to borrow a little money on any particular occasion, or for any particular purpose, what is so likely to obtain him credit as his having been a regular saver in the bank? If he has, unfortunately, not been so steady as he might have been, what is so likely to get him a character as his beginning to put money in the bank? But there is scarcely any end to the advantages of such an establishment to those who choose to avail themselves of it; for unmarried women, especially, it is particularly desirable; they may there place their savings in safety, without trouble or expense; it gives them the best chance of makeing themselves comfortable if they marry, and independent if they do not. As yet savings' banks have not been established long enough to prove more than a very few of the good effects which may be expected from them. They are calculated, however, to serve the country in the best of all possible ways, by enabling every man to serve himself; they hold out encouragement to youth, comfort to middle life, and independence to old age, and a perpetual opportunity to men to improve their condition from generation to generation.—(From "Observations on the Utility and Management of Savings' Banks," written long since by Mr. Walker, and quoted by him in *The Original*, No. XXVII., p. 413.)

No. II.

ROTATION CROPS

FOR A COTTAGE ALLOTMENT OF TWO ACRES.



1 Oats or Barley laid down in Clover
2 Clover for soiling
3 Autumn Potatoes followed by Rape or Stubble Turnip
4 Winter Potatoes
5 Vetches followed by Rape or Stubble Turnip
6 Winter Potatoes
7 Turnips
House, Offices, and Straw Yard
Garden
Lane.

The preceding is a plan of cultivation adapted to a cottage allotment of two acres, and is supposed to be measured off, twenty perches in front by sixteen perches in depth, so that every two perches make a rood, which is marked by a line intended to represent a furrow, communicating with the double line up the middle, representing a path, by which manure may be wheeled up in a barrow from the straw yard. The house, offices, and straw yard are supposed to occupy half a rood, leaving the other half rood for the garden, and the remaining seven roods are for the rotation of crops, which are set down as they ought to stand the first year, and are so contrived that the crop which is in No. 1 field the first year shall be in No. 2 the second year, and so on in No. 3 the third year, until it will have come to No. 7 the seventh year—each crop moving a division on every year; so that, in the beginning of the eighth year, the oats or barley will have come round again to No. 1 field, and all the others in succession, precisely the same as they were at first. This has been so arranged, in consequence of observing that country people are confused by the rotations which are set down in the different publications upon the subject of cottage allotments, which, it is hoped, this arrangement will obviate, as the No. of the fields correspond with the years of the rotation, and point out that the crop in No. 1 the first year, will be 2d, 3d, 4th, or 5th field in the 2d, 3d, 4th, or 5th year of the rotation; and when the field is established in which the first crop of oats or barley is sowed, then all the other crops occupy the following fields in the same succession and order in which they stand in the beginning. By this arrangement the cottager will have one rood of grain, one rood of turnips, three roods of potatoes, one rood of vetches, one rood of clover, and two roods of stolen crop, viz. rape after vetches and stubble, turnip after early potatoes. It is conceived that three roods of well manured land, in potatoes, together with a rood of grain, and the produce of their garden, will, with the milk of the cow, supply food for a man and his wife and two children; and that the rape and stubble turnip, with the rood of *vetches*, *clover* and *turnips*, will feed the cow all summer, and admit of a little clover hay being saved for the winter, besides feeding two store pigs, with the help of cabbage from the garden, the kail which may be reared among the potatoes, and the refuse of the house; and the profit on selling off the grown pigs and laying in younger, with the spare milk and butter of the sow, ought to do more than pay the rent, and perhaps admit of their fattening a pig for their own use.

No. III.

List of different Agricultural Seeds for an English Acre.

Seed Wheat	12 stones	Flaxseed	2½ or 2 bushels
Seed Barley	9 do.	Rape	14 lbs.
Seed Oats	14 do.	Turnip-seed	4 lbs.
Seed Beans in drills	14 do.	Clover-seed	12 lbs. }
Seed Peas in drills	12 do.	With perennial rye grass	1½ pecks }
Seed Vetches	12 do.	Rye grass without clover	3 bushels

No. IV.

List of Garden Seeds in quantities suited to Cottagers' use.

1 Pint of common Peas will sow 14 yards of a drill.
1 Pint of Marrow Peas will sow 20 yards of a drill.
1 Pint of Beans will sow 22 yards of a drill.
1 Ounce of Onion seed will sow 10 square yards.
½ Ounce of Leek seed will 6 square yards.
1 Ounce of Carrot seed will sow 10 square yards.
1 Ounce of Parsnip seed will sow 12 square yards.
½ Ounce of Cabbage, Savoy, Brocoli, or Cauliflower seed will sow between 3 and 4 yards square.

☞ It is supposed that all the above Agricultural and Garden Seeds shall be of best quality, and that the ground they are sowed on shall be completely clean and free from weeds.

No. V.

Extracts from the Account of the Markethill Agricultural Meeting, for the year 1833.

Mr. Ingram being called upon, as having got the first premium, to state the result of his experience in house-feeding, stated that, on a former occasion, he had excited some surprise by declaring that he had paid the entire rent of his farm, consisting of twenty-two acres, by the sale of butter alone—but that he had now the same thing to state over again, as he would do the same this year, which he proved most satisfactorily to the company by a regular detail of what he had already realized. He spoke in the highest terms of the system, and was listened to with the greatest attention.

Mr. Moses Greer, having obtained the first prize in this class, being called on, gave a very clear and satisfactory account of the productive state of his farm—the unnecessary ditches having been all piped and levelled, except one, which would be done before February. That he would then have no unproductive land whatever in his entire farm, and the whole of it in the very best condition. He said his entire stock of three cows were fed upon one acre of clover, and a small quantity of vetches, and that he had no grazing whatever. He said, like Mr. Ingram, that he paid his rent and more by butter, and ascribed the entire improvement in his farm and in his circumstances to his having adopted the plan of house-feeding, which had enabled him to manure his land as it ought to be; and that, in order to increase the quantity of this article, so important to a farmer, he had found it his interest to collect every weed from his ground, and the high road adjoining, for the purpose of bringing them into the cow-house; and that, by attention to this, a farmer would have more manure, from one cow fed in the house, than he would have from three cows fed, as they usually were, upon pasture.

A very animated discussion afterwards took place upon the propriety of harrowing in clover seed upon the growing wheat crop in April and May; and Mr. Beck, of Mecantrim, being referred to, stated that he had been induced to try it in spring, 1832, by the advice of Mr. Bruce, agriculturist on his Lordship's estates, and that it had been attended with the best possible effect. The wheat crop was improved by the harrowing and rolling, and the clover was earlier and more luxuriant than any other in the neighbourhood. He added, that he had followed the same practice this last spring with equal advantage to his wheat crop, and that the young clover was there now to speak for itself, and that nothing could have a more healthy appearance. The general adoption of this plan would prevent the ruinous practice of putting in a crop of oats after wheat, which leaves the land in an impoverished state, but, by interposing a crop of clover, the crop of oats, or winter bere, may be had after it without injury.

Extracts from the Account of the Markethill Agricultural Dinner of 1834.

Moses Greer, of Corlust, as entitled to the first premium, for best stock fed upon the smallest quantity of land—it appearing that he had fed his stock, of four cows and two calves, upon the astonishing small quantity of one acre and two roods of land all summer, being about one rood and four perches for each cow, after allowing for the calves, and had three roods of turnips and one of rape for winter—being called on to give an account of his farming, said: My lords and gentlemen, I hold eight acres and three roods of land, which I have now got into the highest condition; and I shall, in future, be able to keep it so, without going to the expense in lime which I have heretofore been at, by reason of the great quantity of manure I make from my increased stock of cattle, consisting of four cows and two calves; and it will surprise you to hear, my lords and gentlemen, that this stock has been fed this last summer, and up to the present time, on clover and vetches, upon the identical same piece of ground which, when formerly in grazing, fed only one cow, and that very poorly. My land is held part at 23s. and part at 8s. 3d. per acre, and my rent amounts to £7. 14s. 6d. yearly; and I have already sold butter to the amount of £11. 4s. clear of all deductions, and have had enough of milk and butter for myself and my family besides. The abundance of manure has enabled me to set as many potatoes as my neighbours, holding the same quantity of land, and I have as much crop too, besides having my turnips likewise. In conclusion, my lord, I am satisfied there is no way in which land can be made to produce so much, or by which it can be brought into such heart, as by the soiling system and four-course rotation of crops, from which I expect every year to derive greater advantage; as I may say I am only just now beginning to feel the benefit arising from it, my land being now all perfectly clean, every inside ditch levelled, not a spot in the whole that is not productive, and not any of it whatever in pasture.

James Rolston, being next called on, said: I am likewise an advocate for green feeding; I had more clover than fed all the stock I had, although I had more than doubled it, and I was enabled to save three five-fathom cocks of hay, which will leave me all my straw for manure. After cutting my early vetches, I sowed the ground, ridge by ridge, as I cut it, with rape, which I am now cutting a yard long, and giving to my cattle; so that I shall not have to begin to my turnips for some time; and it will be again fit to cut in April next, when the turnips begin to fail. I have also levelled every useless ditch; and my land, so far from being exhausted by the four-course rotation, is every year becoming better.

A discussion here took place whether it was bettor to cut rape now, and again in spring, or to let it stand, and by that means have *one* heavy crop, in which Mr. Matthew Black, Mr. Bruce, and several others, took a share—from which it appeared that their opinion was, there could be no very great difference in the weight, but that, if very far forward, the danger of snow injuring it, and the convenience of having it come in when the clover failed, made it eligible to cut it at this season, when there were no late vetches to supply its place. Mr. M'Kean stated, that it would be much more substantial food by letting it stand to spring, in which Mr. Black agreed.

Mr. INGRAM, having got the premium for best cultivated farm, being called on to give an account of his management, said: I am still of the same opinion as I have formerly expressed, of the benefit to be derived by green crops and house-feeding, which I continue to practice. I find I can thereby increase my stock, and my crop also, and have manure for my potatoes and my turnips; besides, by this means, I find my land improving under the four-course rotation, and though I am paying according to a late valuation, I am still able to say, as I said last year, I shall be able to make my rent from my dairy.

A discussion here arose, whether, by growing turnips, and the practice of house-feeding, the manure would always be so increased that there would be plenty for every purpose; and that any farmer might, thereby, have a greater abundance of potatoes than he otherwise would, and have plenty for his turnips besides. This opinion seemed decidedly to prevail.

THOMAS BRUCE, having got the premium for best crop of turnips, being called on to give an account of his farming, said: When I came into possession of my farm, in 1831, there was no more than about half an acre of potato ground, and this in such a dirty bad condition that it had to be dug over with a grape, in order to clean it, before it could be sowed with grain and clover seed. The rest of the land was in a miserable exhausted state, not fit to produce anything, and I was then possessed of but one cow, and had no meat to feed more; that year I sowed a few turnips upon what manure I had to spare, by employing lime compost for my potatoes, and the next spring, between compost and cow-house manure, I was able to set an acre and half of potatoes, and half an acre of turnips. That year I was able to house-feed, upon the clover and some vetches, two cows, and had plenty for them all winter. Next spring I had so much manure, that, with some assistance from lime compost, I was able to set two acres and a rood of potatoes, and three roods of turnips; and, having sowed more clover, I was enabled that season to keep three cows and a horse—which stock I still have, with the addition of a calf; and have fed them this season on five roods of clover, two roods of vetches, and one rood of grazing; which, being chiefly on a rocky bottom, cannot be broken up. And if an acre was allowed for the keep of the horse, and twenty perches for the calf, this would leave only one rood and four perches for the summer feeding of each cow; and this, with one rood of turnips for each during winter (which would allow, at thirty-four tons per acre, near ninety pounds a day for each for seven months), would only make eighty-four perches, or little more than half an English acre for the year's keep. And I have a rood of rape as a stolen crop besides; so that I have *plenty* of food for them; and my land is improved to such a degree, that there is more than three times the return from it than what it formerly gave; and I shall now be able to keep it in heart by the manure made by house-feeding, without any of the expense for lime which I have been formerly at.

Mr. Herd, Steward to the Earl of Gosford, declared that he considered Swedish turnips as being equally nutritious as any potatoes, and much more wholesome food—that although raw potatoes might fatten stock for market, yet, as a permanent food, there could be no doubt they were unwholesome; and mentioned the result of a wager in Scotland, as to the effects of potato and turnip water on cattle, to decide which, two cows were put up, one of them having potato water mixed with her food, and the other turnip water—the consequence of which was, that the former declined daily, and finally died, whilst the other continued to thrive as well as could be wished. This showed that there must be something unwholesome in the raw potato; for if it was not in the potato it could not get into the water.

Mr. **Bruce** coincided with Mr. Herd, in regard to the injurious effects of potato water and raw potatoes, which produced, in a year or two, inward unsoundness.

Mr. **Nathaniel Greer** stated, that he likewise disapproved of the use of potato water, and also raw potatoes, as a permanent food, but that he considered boiled potatoes and crushed oats to be the food that fattened cattle quickest, which was universally assented to; but the addition of oats destroyed the comparison, and it was said that in general those who favoured potatoes almost always gave some addition of that kind, which was not fully put forth in their calculations.

Mr. **M'Kean** said, that even when cattle were fed on boiled potatoes after turnips, they always fell off in their condition, but when changed from boiled potatoes to Swedish turnips, no falling off, but an improvement took place. On the whole, it appeared that Swedish turnip had the advantage in the opinion of the company.

Extracts from the Account of the Markethill Agricultural Dinner for the year 1835.

Mr. **Bruce**, having obtained the premium for best stock, being called on, rose and said—When he came to his farm, four years ago, he could only keep one cow; and two acres of such pasture as it afforded was barely sufficient to summer feed her—that he had gradually increased his stock from year to year, until he had now three good cows and a horse on his eight acres of land, and had now more acres manured than he then found roods. He had also sold £9 worth of butter this season, and provided for his family consumption, which is not small, and he is making more every week. This will more than pay the rent of his entire farm, and leave the *rest of the produce* to himself, which far exceeds anything the ground ever produced under the old system.

Mr. **Thomas Ingram** said that he had now got his farm into such a rotation, that he never sowed a second crop of grain in succession, the benefit of which he was now fully aware of. He formerly kept but three cows and one horse, now he had seven milch cows, two heifers, and two horses, and can continue to pay his rent by butter alone this season, as well as formerly, and had more grain than he ever had under the old system.

Mr. SIMPSON, being called on, said—I have now had ample experience both of potatoes and turnips, and can declare my opinion to be that the turnips are the most beneficial to the farmer, from the quantity of manure they produce; and I think them more useful under the present increasing quantity of flax culture, than ever they have been before. Flax leaves nothing to renew the soil or enrich the farm, and if the farmer cultivates it to any extent, and do not take some additional means of making manure, his want of foresight will ruin his land and himself too—for he can have neither flax nor any other crop without manure; no other crop makes the same quantity as the turnip crop, and, by growing it extensively, I find I can have more manure for my potatoes than I otherwise would, and have plenty for my turnips besides. I can further say, since I became extensive in green-feeding, I have added from six to seven acres to my crop, and have greatly increased my stock besides.

Mr. NATHANIEL GREER fully concurred in the same opinion, which was confirmed by Mr. Bruce and several others.

JAMES BRADFORD and JOHN HOGG, having obtained premiums for the best cultivated farms on the four-course rotation, James Bradford, being called on, said—When I came under Lord Gosford, I owed £5 an acre of arrears; I had no property whatever, nor meat for my family. I have now, thank God, and the assistance he has been pleased to send me through Mr. Blacker, plenty of provisions to do me until next crop, though I had none then. I have also two cows and a pig, and then I had neither one nor other. My land, also, is now in heart, and produces as much in one year as it then would in three; and this season I expect to pay up all the arrears that are against me, and I will only owe the purchase-money of a small piece of land his honour added to my farm, as an encouragement; and when I get clear of this I think I will be comfortable, and very thankful for all that has been done for me.

JOHN HOGG was then called on, and stated that he had been in distressed circumstances before Lord Gosford bought the property, and was intending to go to America; but having got encouragement from Mr. Blacker, he had followed his advice, and his farm was now all under the four-course rotation: he had two cows and a horse, had a cart and a plough; owed no rent now, though he was deep in arrear formerly; had bought more land, and was in the way of doing well. The new system kept himself and family all busy, and paid them well for their labour. He formerly had been obliged to pay £7 for potatoes for his family, and now he had £3 worth to sell, owing to the manure from his turnips.

Mr. **MITCHELL**, having got premium for best crop of rape after vetches, stated that he had greatly increased his stock and improved his land by the practice of green crops and house-feeding, and that he would be able to improve more still by the same means. He was only just commencing, but he would be able to say more next year. In the mean time, he could say the house-feeding was the best thing ever was introduced.

JOHN WHITTLE, having got premium for best rape after a grain crop, stated that he had formerly only one cow and a horse upon six and a half acres. He had since, for his exertions, got from Mr. Blacker the addition of another acre, and he now kept *well* two cows, two heifers, and his horse. He had levelled all his ditches, and filled up an old quarry, and covered rocks with soil, so as to gain a full rood of land, on which he had this day a capital crop of turnips, and had his rape after his grain by stooking the grain crop in one side of the field, and sowing the other, and giving it the summer manure, which he had plenty of.

MICHAEL CLARKE,* being called on, said—When Mr. Blacker first came to my house I had fallen into arrear; distress of mind, and ill health that it brought on, had driven me to a state of despondency; I did not care what became of me, or whether I was turned out or not. I was in despair; and my family in misery, surrounding me. He told me he would help me if I would do as he directed, and that he would send a person to instruct me, and that the place would be worth having if it got justice. I did not believe that it ever would have turned out as he said it would; but, as he was so kind, I promised I would take heart again and do as I was bid; accordingly, Mr. Bruce came and pointed out what was to be done. I got up my spirits, and my health got better. Mr. Blacker lent me a cow, when I had got clover to feed her on. The first year I was able to pay nothing, but he saw I was doing my endeavour, and he did not press me. The next year, I paid a year and a half; the one after, I paid another year and a half; and the one following, I paid two years; and now I expect to be able to clear off all, and to have my cow and pig to myself. I have a new loom besides; and all my ditches are levelled, and the whole farm in good heart. My health is got better, and I have no more to say, gentlemen; but, thank God and his honour, I am in the way of doing well. I have meat for myself, and meat for my cow, and meat for my family, all provided for the next twelve months, and it is long since I was able to say so before.

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* This is the man who is alluded to in Mr. B.'s Pamphlet, who had his daughter assisting him in wheeling earth in a barrow.

The Chairman then rose and said—Gentlemen, I cannot help calling your attention to the competitors in this class; their example shows what *diligence gains* and *negligence loses*. These, you see, have gained their rape crop after their grain upon the same ground, by stooking the corn as it was cut on one side of the field, and manuring and sowing the cleared part of the stubble; and so have now to congratulate themselves on having, by this means, obtained ample food for their stock for six weeks of the year most trying to the small farmer, viz. from the first week of April to the middle of May.

Mr. Moses Greer then said—When I came under his Lordship I was a tradesman, and had just saved as much as enabled me to buy a bit of land of about five acres from my father, out of his farm; but I was without stock, or manure, or skill how to labour it. Mr. Bruce, the Agriculturist, came about, and, as he reported me willing to work, Mr. Blacker gave me every assistance I stood in need of. As I succeeded well, he laid me off more land, and last year I cleared off all that was against me; and this year the farm adjoining me being to be sold, I ventured to buy it, seeing the way that lime and manure, and draining and weeding, made land produce; and I am not afraid of getting on, as I am happy to say I have now, not *three* times, but *four* times the quantity of land I started with, all but a rood, and am doing as much as I possibly can to bring it to a proper state; and next year I think I will be higher placed in the premium list.

Extracts from the Account of the Markethill Agricultural Dinner, for the year 1836.

According to the usual practice, the health of JAMES JENKINS was given, as having obtained the first premium for stock, and he was afterwards called upon to state what advantage he had derived from the plan he was pursuing: this he did in a manner very satisfactory to the company. He said—

I am able to say, gentlemen, that since I have followed the plan recommended by Mr. Blacker, I have been able to change my stock, with considerable profit to myself, from a very bad stock to a very good one, as my getting the first premium shows; and though I was then pinched to feed them poorly, I have now plenty to feed them well; and whereas I had only two cows, a heifer, and a poney formerly, I have now five cows, two heifers, and one good horse, on my sixteen acres, kept on clover and vetches in summer, on cabbage at this season of the year, and turnips in winter and spring. I prefer early York and sugar-loaf, and flat Dutch cabbage, to the curled kail, for they give more food at this season; and if the plants are put in about three inches under the manure, the potatoes can be dug out without injuring them, and as they grow into the trench they do not overshadow or injure the potato as the curled kail does. I am also happy to tell you, gentlemen, that I find the produce of my farm is increased, as well as my stock. Formerly I could manure but an acre and a half of potatoes, and that but indifferently, but now I have this year four acres of potatoes and turnips manured in the very best fashion; and you all know the more manured land you have in the farm, the more grain you will get out of it. Many gentlemen, from distant parts, have come to *see* my farm, and I am always glad to *see* them, and have always something pleasing to show them. Gentlemen, I have nothing more to say, but that I am well content, and determined to persevere in the plan I have now been so much the better of.

SAMUEL PARKS, of Lurgyross, being next called on, said—I hold 4A. 2R. 20P. of land, at a rent of £4. 9s. 2d.: upon this I feed two cows; and, after providing my family, I have sold £7 worth of butter and milk, being one-half more than my rent. My cows are house-fed, and in capital condition, as my getting a premium shows.

After him, JOSEPH THOMPSON, of Grayhilla, was called on. He said—I have 11A. 3R. of land, and on this I have three cows, a heifer, and a horse. The half of my land was formerly in grazing, and my stock far inferior in number and condition. I consider the four course rotation as an excellent plan, and mean to persist in it; and I think I will be able to increase my stock next season from the fine appearance my clover now has.

The Chairman then introduced the reading of the premiums for the best cultivated farms, according to the four-course rotation, by stating that the smallness of the quantity of land kept in grazing proved, in a great degree, the profitable occupation of the rest of the land, and mentioned that the certificate had been given to Mr. Thomas Ingram, of Drumhoney, who I have, in former accounts, had often to mention.

The list being read out, the Chairman reminded Mr. Ingram, who had got the certificate, how doubtful some of the company were formerly about the produce of his dairy, and asked him had he now the same thing as then to say about paying his rent thereby?

Mr. INGRAM, being thus called on, said—Gentlemen, I cannot only say the same thing, but I can say better. I hold twenty-three acres of land, and nobody can say that I hold it too cheap, when I tell them I pay £25 a-year rent. My stock is seven cows, two heifers, one calf, and two horses, and they are all in good condition; the butter has already produced £26, which is a pound over the rent, and I expect to make it £30 before the year is out, as the price is so high. And I will tell you more, gentlemen, I had nine hundred stooks of excellent oats and an acre of flax, and all early in and well saved, so that I could make four times my rent off my farm.

This account seemed to give the greatest pleasure to all present, and Mr. Ingram's health was drank most cordially. The mention of the produce of Mr. Ingram's dairy afforded much surprise, as he keeps three farm servants, and must, therefore, have great consumption at home. The Chairman, however, said he understood there was another in the list that would surprise them still more. He then passed a high encomium on Michael Clark's farm, in which, he said, there was not the space of a single foot neglected; and also noticed Ruth M'Connell, who, by her own exertions, had made a small piece of ground, (which had merely fed a goat before, and never yielded more potatoes than lasted until Christmas,) now to keep a cow right well, and supply potatoes for the year.

The Chairman here adverted to the advantage of turnip feeding, and expressed his surprise that so many people would be so blind to their own interests as not to see the advantage of it. He stated that a rood of well-cultivated turnips would yield from eight to ten tons, or even much more, supposing the crops to be part white, yellow, and Swedish. This, therefore, would give from eighty to one hundred pounds a-day for a cow for seven months, or two hundred and ten days. Now, even a springer will give two quarts of milk more upon turnips than on either hay or straw. A stripper might increase four, and a new calved cow would give seven or eight quarts more. But taking it at two quarts, which is the lowest, these two quarts are worth two pence per quart all winter and spring; and four pence per day, for two hundred and ten days, is exactly seventy shillings gained in extra milk by one rood of turnips, which is fourteen pounds to the acre. Thus the extra quantity pays fourteen pounds per acre for the turnips, and you have all the cow would have given without them for nothing, or next to nothing, and the manure besides. This is as plain as that two and two make four, and yet it would appear that people could not see it.

Mr. **Parks** here rose and said, he had bought a springer that did not give two pints, and upon giving her turnips she gave four quarts.

The Chairman, in giving the health of Mr. Bruce, requested him to say how it happened that his field of turnips was quite green without a single yellow leaf, and Mr. Singleton's, at the opposite side of the road, was quite yellow with the number of leaves that were decayed.

Mr. **Bruce**—Gentlemen, this is very easily accounted for. Mr. Singleton, and almost all others, think when the leaves begin to cover the ground, that the horse-hoe or pony-plough is no longer necessary, and that the horses travelling through will injure the crop. Now, I think the reverse; and I ran the pony-plough three times through *mine* after they had attained the same growth that Mr. Singleton and others stop at. The consequence is, that mine are still in the height of their growth, and will grow on until Christmas, whilst theirs are stunted, and will not yield within one-third of the weight they would otherwise have done.

Robert Mitchell, being next called, said his farm formerly produced him no more than about £8. 16s. which was the rent he then paid; he now had to pay more, but, by the new system, he had last year made £44. 5s. 4d. out of it, leaving plenty of food for himself and nine of a family. He had also increased his stock from one cow to three cows and a horse; and he saw clearly that by going on as he was doing, he could have three times as much potatoes, oats, and flax as ever he had formerly.

The premium list for rape was then read over, by which it appeared—

Mr. Anderson, of Drummard, got	the 1st premium.
Edward Coyne, of Drumgaw,	the 2d ditto.
Thomas Scott, of Dirlet,	the 3d ditto.

Mr. Anderson bore testimony to the advantages he had derived in the increase of his stock and crops. He stated he had sowed his rape in August, after flax, and that he had saved this year twenty-five bushels of winter vetches seed from less than an acre of land.

The Chairman here pointed out the necessity of early sowing both rape and winter vetches, and that not a moment should be lost in putting them in even, ridge by ridge, as fast as the ground could be cleared of the crop preceding—observing that a week in August was worth the whole month of October. He also noticed that Mr. Anderson had made near £12 an acre by his vetches, and recommended the more general sowing of that crop for seed.

Letter from G. Meara, Esq. as to the Making-up of Butter in the County of Waterford.

"May Park, Waterford, Nov. 10, 1836.

"My dear Mr. Blacker—I have made the inquiry you wish for in your letter, which I received yesterday. There is a pretty good supply of fine butter at the Waterford market, which brings within a few shillings per cwt. of the Dutch in England; but the quantity made up as Dutch, packed in similar casks to Dutch, is very trifling, those casks being large, about one cwt., whilst the usual Irish package is a firkin, about three quarters gross, or sixty-five to seventy pounds. In the make of butter the milk or cream should *not* be suffered to sour, but churned sweet, and the milk well washed out, with as little handling as possible; the quantity of salt to each firkin not to exceed four pints; and if the butter be intended for early consumption, but three pints of salt will be sufficient. The salt should be made as fine as possible, and when the finest salt cannot be had, it should be pulverised with a rolling pin: about a tea-spoonful of saltpetre to each firkin, is considered by some an improvement. The Dutch casks are made of seasoned ash, with osier hoops, twelve in number, and peeled, which gives the cask a white, neat appearance; each cask contains from one hundred to one hundred and twelve pounds of butter. This package is nearly given up here, and almost all the butter goes in firkins, full bound; most particular attention should be given to have the butter well packed, and that the timber be well-seasoned, of which the package is made.

" I believe I have answered all the butter queries, and shall be happy, at all times, to hear from you on any subject.

" Believe me yours, very truly,

" GEORGE MEARA."

Letter from S. Corry, Esq. Newry, on same subject.

" Newry, 15th November, 1836.

" DEAR SIR—From the best information I can collect, on the subject of making up butter in this country, too much salt is used. One ounce of good *Irish* salt to the pound of butter is sufficient, and butter so made up would command a better price.

" S. CORRY."

George Scott's Account of his Experiment in feeding Milch Cattle upon boiled Turnips and steamed cut Hay.

" TO WILLIAM BLACKER, ESQ.

" SIR—By giving the following statement publicity, with the proceedings of the farmers' dinner, it may be of use to some of its readers. I tried the experiment, as directed by you, of feeding with boiled turnips and steamed hay, cut, and I find a great deal more benefit by it in the increase of milk than feeding with the raw turnip. I began to feed one springing cow in the month of February; at that time she was giving about four quarts per day with the above feeding, together with a little bran. The increase of milk in one week was two quarts per day. I would recommend this feeding of milch cattle to persons that have plenty of firing. A springer fed in this way in winter will give a great deal more milk when calved in summer.

"I remain, your obedient servant,

"George Scott.

"Lurgaboy, November 18th, 1836."

Statement of the quick growth of Italian Rye Grass, by Mr. O'Neill.

Italian Rye Grass, sown June 23d, 1836, measured eighteen inches, August 8th; twenty-four and a half inches, August 12th; thirty-one and a half inches, August 15th; thirty-three inches, August 21st.

No. VI.

Quality of Milk during the Process of Milking.

Several large coffee-cups having been successively filled from one cow, till she was quite dry, the following results appeared, great care having been taken to weigh the cups to ascertain that they held exactly the same quantity. In every case the quantity of cream was found to increase in proportion as the process of milking advanced. In different cows the proportion varied, but in the greater number the excess of cream in the last cup, as compared with the first, was as sixteen to one; in some it was not so considerable; therefore, as an average, it may be called as ten or twelve to one. The difference in the quality of the two sorts of cream was no less striking; the cream given by the first-drawn milk was thin, white, and without consistence, while that furnished by the last was thick, buttery, and of a rich colour. The milk remaining in the different cups presented similar differences: that which was drawn first, was very poor, blue, and had the appearance of milk and water; that in the last cup, was of a yellowish hue, rich, and, to the eye and taste, resembled cream rather than milk. It appears, therefore, from these experiments, that if, after drawing seven or eight pints from a cow, half a pint remains in the teats, not only almost as much cream will be lost as the seven or eight pints will furnish, but that of the best quality, and which gives the richest taste and colour to butter. This fact has been corroborated by chemical experiments, and holds good with respect to goats and asses.

No. VII.

Mr. Anderson's Statement, as Agriculturist on Richhill Estate.

In 1831, about twenty tenants sowed clover, and about the same number had turnips. The proprietors of the estate offered premiums for turnips, and there were only three competitors in that year.

In 1832, fifty-three persons sowed clover and fifty had turnips.

In 1833, premiums were offered for the best clover, and there were fifty-one competitors, holding under twelve acres each. Also one hundred persons had turnips.

In 1834, one hundred and fifty-six persons sowed clover, and two hundred and fifty-six had turnips; and premiums having been offered for house-feeding, ninety-four persons house-fed their cattle.

In 1835, two hundred and eighty-seven persons sowed clover, and two hundred and sixty-seven have turnips, (not including small patches;) one hundred and sixteen persons had vetches, and one hundred and nineteen are now house-feeding their cattle.

No. VIII.

Feeding Cattle on Flaxseed.—System of Mr. Wm. Taylor, Agriculturist to Lord Viscount Bangor.

Bruise the seed at a mill, or make it into meal; then take as much cut hay, or straw, or chaff, as will make a sufficient feed for your cow, or horse, &c. and put it into a pail or tub, and mix your linseed meal with it, and pour on boiling water sufficient to wet it well; cover it up closely, so as to prevent the steam escaping, and let it stand until cold, or nearly so (I have always found hot food injurious to cattle); two quarts of linseed meal, given daily to cow or horse, will add very much indeed to their fattening, and, of course, both to the quantity and quality of the cow's milk, but particularly to the quality. I have fed and fattened cattle both on linseed meal and linseed cake, mixed with cut hay, &c. and a little cold water sprinkled over it so as to make the meal stick to the hay, &c. and always found the cattle thrive, and fatten uncommonly well on it. Linseed gruel is an excellent food for calves; and I have always found them thrive better with a little of it in their milk, than when fed solely on milk: and I seldom or never found a diseased calf that was partly fed on linseed gruel. I generally allowed one quart to each calf, at each end of the day, in lieu of as much milk, until they were six weeks old, after which I gave them, by degrees, four quarts daily, deducting the milk as I added the gruel. One quarter linseed meal, when boiled about an hour, will make three quarts of excellent gruel. The calves got so fond of it, after getting it for some time, that they wont take their milk without it, except when very hungry indeed. Linseed should always be bruised, or made into meal, before it is given to any sort of cattle, otherwise they will void more or less of it whole, which is of little or no use to them.

No. IX.

Method of Curing Butter, strongly recommended in Irish Agricultural Magazine, by which it is said it may be preserved for years without any unpleasant taste.

Take *two* parts of the best common salt, as fine as can be had, *one* part of sugar, and *one* part of saltpetre; beat them up together, and blend the whole completely: take one ounce of this composition for every sixteen ounces of butter, work it well into the mass, and let it stand one month closed up before being opened for use. It requires this time to let the ingredients incorporate.

A FEW REMARKS ON THE LARGE HEDGES AND SMALL ENCLOSURES OF DEVONSHIRE, AND THE ADJOINING COUNTIES:

BY JOHN GRANT,

SURVEYOR AND LAND AGENT, EXETER.

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REMARKS,

&c.

Every practical farmer coming into Devonshire for the first time is struck with the fertility of the soil and the genial climate with which the county is favoured. He may not be equally struck with the quality of the farming, though this has of late made an immense stride; but is certainly astonished at the small quantity of the produce of the soil returned per acre, a much greater being produced in districts immeasurably behind Devon in natural advantages. A superficial observer places this to the credit, or rather discredit, of the farmer: the practical man is not long in discerning that not the least of the causes is the baneful effect of the high hedge-rows and small enclosures, which add so much beauty to the scene at so great a cost to the landlord and tenant.

Struck with these reflections I resolved to make some actual measurements, in order that the Landed Gentry and Agriculturists of the county might see the full extent of the evil.

At the present time there is a strong tendency towards improvement in agriculture; it being the general opinion that none of the sciences is in so backward a state: but no very great advance can be made, so long as in this, and a great part of the adjoining counties, the enclosures are so small, and the hedges so many and great, that upwards of seven per cent. of the land is occupied; besides that which is otherwise injured by them. "What," it has been asked me by more than one intelligent and extensive farmer, "is the use of our being told that we should study practical chemistry, and copy the example of farmers in better cultivated districts, if we are not allowed to enlarge our fields by taking down those immense banks, or even to cut down the wood growing on them but once in seven years, and then only that which has not been previously marked for rearing? Look at what I lose from the shade of these hedges and trees, besides what they actually occupy—nearly a ridge wide on each side, so that the corn is hardly worth reaping." And who can deny that this is discouraging? Is it not every where in the county, and every year to be seen? The necessity of making extensive alteration in this respect will, I trust, be evident by consulting the following Table, which gives the total number of acres in each of ten parishes, all within a circuit of fifteen miles of Exeter, and extending over a district of twenty miles; varying from 700 to 9,000 acres, and amounting to nearly 37,000 acres: also the number of miles of hedge, the number of acres and per centage occupied by them; the number of cultivated enclosures of different sizes above half an acre, all under that size being left out as gardens, &c. No enclosures are taken into account but such as are cultivated by the farmer; that is to say, they are arable, pasture, or orchard; and do not include coppices, woods, plantations, &c., which in most cases are in the hands of the landlords. The tithe apportionments have been my authority for the number of fields of different sizes. Fractions are as much as possible avoided, as being unnecessary, and preventing confusion. In some of the parishes there are parks, commons, and large woods, which, if deducted, would make the per centage much greater on the portions which are divided.

A TABLE.

Name of Parish.	Total acres in the Parishes.	Miles of Hedge in the Parishes.	Acres occupied by Hedges in the Parishes.	Per Centage occupied by Hedges.	Equal to one in	Enclosures between ½ acre and 1 acre.	Enclosures between 1 acre and 2 acres.	Enclosures under 2 acres.	Enclosures between 2 acres and 3 acres.	Enclosures under 3 acres.	Enclosures between 3 acres and 4 acres.	Enclosures under 4 acres.	Enclosures between 4 acres and 5 acres.	Enclosures under 5 acres.	Enclosures between 5 acres and 6 acres.	Enclosures under 6 acres.	Enclosures between 6 acres and 7 acres.	Enclosures under 7 acres.	Enclosures between 7 acres and 8 acres.	Enclosures under 8 acres.	Enclosures between 8 acres and 9 acres.	Enclosures under 9 acres.	Enclosures between 9 acres and 10 acres.	Enclosures under 10 acres.	Enclosures of 10 acres and upwards.	Total number of cultivated Enclosures in Parishes.
Huxham	762	34	54	7	14	16	14	30	23	53	26	79	16	95	14	109	9	118	8	126	4	130	3	133	9	142
St. George's Clyst.	1040	52	83	8	12$\frac{1}{3}$	35	57	92	34	126	37	163	29	192	18	210	23	233	8	241	8	249	6	255	9	264
Rewe	1341	65	104	7$\frac{3}{4}$	12$\frac{9}{10}$	33	47	80	71	151	56	207	33	240	29	269	13	282	14	296	9	305	11	316	8	324
Poltimore	1710	59	94	5$\frac{1}{2}$	18	27	50	77	48	125	43	168	25	193	20	213	18	231	11	242	9	251	8	259	38	297
Clisthydon	1725	86	138	8	12$\frac{1}{5}$	26	52	78	69	147	81	228	59	287	39	326	41	367	15	382	14	396	7	403	4	407
Feniton	1822	95	152	8$\frac{1}{4}$	12	48	71	119	74	193	68	261	67	328	45	373	31	404	17	421	15	436	7	443	6	449
Talaton	2365	114	182	7$\frac{3}{4}$	12$\frac{2}{10}$	57	105	162	90	252	89	341	76	417	49	466	31	497	21	518	10	528	7	535	13	548
Silverton	4714	222	356	7$\frac{1}{3}$	13$\frac{1}{4}$	92	161	253	161	414	173	587	168	755	110	865	70	935	58	993	27	1020	11	1031	35	1066
Broadclyst	9188	383	613	6$\frac{2}{8}$	15	188	348	536	336	872	304	1176	243	1419	197	1616	115	1731	94	1825	55	1880	33	1913	57	1970
Crediton	12309	541	866	7	14$\frac{1}{4}$	283	442	725	387	1112	343	1455	299	1754	222	1976	160	2136	111	2247	80	2327	55	2382	148	2530
Total	36976	1651	2642	7$\frac{1}{7}$	14	805	1347	2152	1293	3445	1220	4665	1015	5680	743	6423	511	6934	357	7291	231	7522	148	7670	327	7997

In the Table it is shown that in the parish of Huxham, containing 762 acres, there are 34 miles of hedge, which occupy 54 acres, being 7 per cent, or 1 acre in 14. There are 16 enclosures between ½ an acre and 1 acre; 14 between 1 and 2 acres, being 30 under 2 acres: 23 between 2 and 3 acres, or 53 under 3 acres: 26 between 3 and 4 acres, being 79, or 55 in every 100 fields under 4 acres: 16 between 4 and 5 acres, or 95 under 5 acres: 14 between 5 and 6 acres, or 109 under 6 acres: 9 between 6 and 7 acres, or 118 under 7 acres: 8 between 7 and 8 acres, or 126 under 8 acres: 4 between 8 and 9 acres, or 130 under 9 acres: 3 between 9 and 10 acres, or 133 under 10 acres: 9 of 10 acres and upwards, being 142 in all: and 1 field larger than 10 acres in every 16 fields, or in 100 acres. There is a portion of the parish, containing 84½ acres, in which there are 5 miles of hedge, containing about 8 acres; being 9½ per cent, or 1 in 10½. Lately there have been more than 3 miles of hedge taken down, thus saving between 5 and 6 acres.

In the Parish of St. George's Clyst, containing 1,040 acres, there are 52 miles of hedge, occupying 83 acres, being 8 per cent, or 1 in 12½. There are 35 enclosures between ½ an acre and 1 acre; 57 between 1 and 2 acres, or 92 under 2 acres: 34 between 2 and 3 acres; being 126, or about half, under 3 acres: 37 between 3 and 4 acres, being 163, or 61 of every 100 fields under 4 acres: 29 between 4 and 5 acres, or 192 under 5 acres: 18 between 5 and 6 acres, or 210 under 6 acres: 23 between 6 and 7 acres, or 233 under 7 acres: 8 between 7 and 8 acres, or 241 under 8 acres: 8 between 8 and 9 acres, or 249 under 9 acres: 6 between 9 and 10 acres, or 255 under 10 acres: 9 of 10 acres and upwards: being 264 in all: and 1 field larger than 10 acres in every 30 fields, or in 115 acres. In the upper half of this parish the hedges occupy 10 per cent, but the large marshes in the lower half reduce it to 8 per cent. If we take 78½ acres in one part of the parish we find 6 miles of hedge, occupying between 9 and 10 acres; being 12 per cent, or 1 in 8½.

In the Parish of Rewe, containing 1341 acres, there are 65 miles of hedge, occupying 104 acres; being 7¾ per cent, or 1 in $12\frac{9}{10}$. There are 33 enclosures between ½ an acre and 1 acre; 47 between 1 and 2 acres, or 80 under 2 acres: 71 between 2 and 3 acres, or 151 under 3 acres: 56 between 3 and 4 acres; being 207, or 64 in every 100 fields under 4 acres: 33 between 4 and 5 acres, or 240 under 5 acres: 29 between 5 and 6 acres, or 269 under 6 acres: 13 between 6 and 7 acres, or 282 under 7 acres: 14 between 7 and 8 acres, or 296 under 8 acres: 9 between 8 and 9 acres, or 305 under 9 acres: 11 between 9 and 10 acres, or 316 under 10 acres: 8 of 10 acres and upwards; being 324 in all: and 1 field larger than 10 acres in every 40 fields, or 170 acres. If we take a separate portion of the parish, containing 81 acres, we find 5½ miles of hedge, occupying 9 acres, being one ninth. This part of the parish is rented at 40s. per acre, and the outgoings are from 12 to 15 shillings more; so that there is an annual loss of, at least, £23 on these 81 acres.

In the Parish of Poltimore, containing 1,710, there are 59 miles of hedge, occupying 94 acres; being 5½ per cent, or 1 acre in 18. There are 27 enclosures between ½ an acre and 1 acre; 50 between 1 and 2 acres, or 77 under 2 acres: 48 between 2 and 3 acres, or 125 under 3 acres: 43 between 3 and 4 acres; being 168, or 56 in every 100 fields under 4 acres; 25 between four and 5 acres, or 193 under 5 acres: 20 between 5 and 6 acres, or 213 under 6 acres: 18 between 6 and 7 acres, or 231 under 7 acres: 11 between 7 and 8 acres, or 242 under 8 acres: 9 between 8 and 9 acres, or 251 under 9 acres: 8 between 9 and 10 acres, or 259 under 10 acres: 38 of 10 acres and upwards; being 297 in all: and 1 field larger than 10 acres in every 8 fields, or 45 acres. The park and roads in this parish amount to 140 acres. In a part of the parish, containing 115 acres, the hedges occupy 10¼ per cent; in another part, containing 280 acres, they amount to 6 per cent; but in another, containing 327 acres, they are only 2½ per cent. Before the apportionment of this parish was made, five years ago, Lord Poltimore's Steward took down on a farm of less than 200 acres 8 miles of hedge, and thereby added 15 acres to the productive portion of the estate. Since that time there have been removed in the parish 6½ miles of hedge, saving about 10 acres; so that there have been taken down in the last five years, besides what were taken down before, on Lord Poltimore's property, in the parishes of Huxham and Poltimore, 10 miles of hedge, and from 15 to 16 acres gained: as much as would be an allotment of a third of an acre to each of about fifty labourers. On account of these alterations the number of enclosures of 3, 4, and 5 acres would be much fewer, and those of a larger size greater, than is given in the Table. Whilst in the parish of Rewe, containing 1,341 acres, there are 65 miles of hedge; in Poltimore, which is nearly a half larger, there are only 59; and if we deduct the 6½ since taken down, only 52½ miles. It will also be perceived that this, containing 1,710 acres, contrasts favourably with the other parishes, having about as many enclosures above 10 acres as are in the five parishes of St. George's Clyst, Rewe, Clisthydon, Feniton, and Talaton, containing 8,293 acres: also with the parishes of Silverton and Broadclyst, having two thirds as many enclosures above 10 acres as the latter parish, which is 9,188 acres.

In the Parish of Clisthydon, containing 1,725 acres, there are 86 miles of hedge, occupying 138 acres, being 8 per cent, or 1 in 12½. There are 26 enclosures between ½ an acre and 1 acre; 52 between 1 and 2 acres, or 78 under 2 acres: 69 between 2 and 3 acres, or 147 under 3 acres: 81 between 3 and 4 acres, or 228, being 56 in every 100 fields, under 4 acres: 59 between 4 and 5 acres, or 287 under 5 acres: 39 between 5 and 6 acres, or 326 under 6 acres: 41 between 6 and 7 acres, or 367 under 7 acres: 15 between 7 and 8 acres, or 382 under 8 acres: 14 between 8 and 9 acres, or 396 under 9 acres: 7 between 9 and 10 acres, or 403 under 10 acres: 4 fields of 10 acres and upwards; being 407 in all; and 1 field larger than 10 acres in every 102 fields, or in 431 acres.

In the Parish of Feniton, containing 1,822 acres, there are 95 miles of hedge, occupying 152 acres; being 8⅓ per cent, or 1 acre in 12. There are 48 enclosures between ½ an acre and 1 acre; 71 between 1 and 2 acres, or 119 under 2 acres: 74 between 2 and 3 acres, or 193 under 3 acres: 68 between 3 and 4 acres, being 261, or 60 in every 100 fields under 4 acres: 67 between 4 and 5 acres, or 328 under 5 acres: 45 between 5 and 6 acres, or 373 under 6 acres: 31 between 6 and 7 acres, or 404 under 7 acres: 17 between 7 and 8 acres, or 421 under 8 acres: 15 between 8 and 9 acres, or 436 under 9 acres: 7 between 9 and 10 acres, or 443 under 10 acres: 6 of 10 acres and upwards, being 449 in all: and 1 field larger than 10 acres in every 75 fields, or 304 acres.

In the Parish of Talaton, containing 2,865 acres, there are 114 miles of hedge, occupying 182 acres; being 7¾ per cent, or 1 in 12$\frac{2}{10}$. There are 57 enclosures between ½ an acre and 1 acre; 105 between 1 and 2 acres, or 162 under 2 acres: 90 between 2 and 3 acres, or 252 under 3 acres: 89 between 3 and 4 acres, being 341, or 62 in every 100 fields under 4 acres: 76 between 4 and 5 acres, or 417 under 5 acres: 49 between 5 and 6 acres, or 466 under 6 acres: 31 between 6 and 7 acres, or 497 under 7 acres: 21 between 7 and 8 acres, or 518 under 8 acres: 10 between 8 and 9 acres, or 528 under 9 acres: 7 between 9 and 10 acres, or 535 under 10 acres: 13 of 10 acres and upwards, being 548 in all: and 1 field larger than 10 acres in every 42 fields, or in 182 acres. The divided part of this parish would appear much worse if the common, park, and roads were deducted, as they amount to 180 acres, or more than one twelfth of the whole.

In the Parish of Silverton, containing 4,714 acres, there are 222 miles of hedge, occupying 356 acres; being 7½ per cent, or 1 in 13¼. There are 92 enclosures between ½ an acre and 1 acre; 161 between 1 and 2 acres, or 253 under 2 acres: 161 between 2 and 3 acres, or 414 under 3 acres: 173 between 3 and 4 acres, being 587, or 55 in every 100 fields under 4 acres: 168 between 4 and 5 acres, or 755 under 5 acres: 110 between 5 and 6 acres, or 865 under 6 acres: 70 between 6 and 7 acres, or 935 under 7 acres: 58 between 7 and 8 acres, or 993 under 8 acres: 27 between 8 and 9 acres, or 1,020 under 9 acres: 11 between 9 and 10 acres, or 1,031 under 10 acres: 35 of 10 acres and upwards; being 1,066 in all: and 1 field larger than 10 acres in every 30 fields, or in 134 acres.

There is a park of 113 acres in this parish. When the Railway is made to Totnes the hedges in this parish would make a bank from that place through Exeter and Bristol, by the Great Western Railway, to London, and this too without taking into account some miles of water boundary formed by the river Culm, and brooks. That 356 acres, or an average of 7½ per cent should be occupied by hedges in this one parish seems bad enough; but there are parts of it much worse in proportion. In 147 acres at the south east end, which I surveyed, I found more than 9 miles of hedge, occupying 14½ acres, or fully 10 per cent. When to this is added the further injury otherwise caused by these hedges, as mentioned elsewhere, it will be self evident how utterly impossible it must be for the farmer of such densely wooded districts to compete with those who are living on more open, and therefore more productive, farms.

In the Parish of Broadclyst, containing 9,188 acres, there are 383 miles of hedge, occupying 613 acres, being 6⅔ per cent, or 1 in 15 acres. There are 188 enclosures between ½ an acre and 1 acre; 348 between 1 and 2 acres, or 536 under 2 acres: 336 between 2 and 3 acres, or 872 under 3 acres: 304 between 3 and 4 acres, being 1,176, or 60 in every 100 fields under 4 acres: 243 between 4 and 5 acres, or 1,419 under 5 acres: 197 between 5 and 6 acres, or 1,616 under 6 acres: 115 between 6 and 7 acres, or 1,731 under 7 acres: 94 between 7 and 8 acres, or 1,825 under 8 acres: 55 between 8 and 9 acres, or 1,880 under 9 acres: 33 between 9 and 10 acres, or 1,913 under 10 acres: 57 of 10 acres and upwards; being 1,970 in all: and 1 field larger than 10 acres in every 34½ fields, or 161 acres. The per centage occupied by hedges in this parish is 6⅔, or 1 in 15;

but if we were to deduct 977 acres for large woods, the park, roads, &c., it is evident that the per centage to be allowed for hedges on what would remain would be very much increased. I surveyed a part of the parish containing 133 acres, which is divided into 44 enclosures, averaging 3 acres, on which there are 8½ miles of hedge, occupying 13½ acres, or fully 10 per cent. The hedges in this parish would make a bank of earth between the capitals of England and Scotland.

In the Parish of Crediton, containing 12,309 acres, there are 541 miles of hedge, occupying 866 acres; being 7 per cent, or 1 acre in 14¼. There are 283 enclosures between ½ an acre and 1 acre; 442 between 1 and 2 acres, or 725 under 2 acres: 387 between 2 and 3 acres, or 1,112 under 3 acres: 343 between 3 and 4 acres, being 1,455, or 58 in every 100 fields under 4 acres: 299 between 4 and 5 acres, or 1,754 under 5 acres: 222 between 5 and 6 acres, or 1,976 under 6 acres: 160 between 6 and 7 acres, or 2,136 under 7 acres: 111 between 7 and 8 acres, or 2,247 under 8 acres: 80 between 8 and 9 acres, or 2,327 under 9 acres: 55 between 9 and 10 acres, or 2,382 under 10 acres: 148 of 10 acres and upwards, being 2,530 in all: and 1 field larger than 10 acres in every 17 fields, or 83 acres. The hedges of this parish would more than extend from the Land's End through the centre of England to Edinburgh in Scotland.

The result of this examination of ten parishes, containing 36,976 acres, being an average size of about 3,700 acres, is, that there are 1,651 miles of hedge; about half as long again as the famous wall of China; or sufficient to hedge round the whole of England with an immense bank of earth, and occupying 2,642 acres; being 7⅐ per cent, or 1 acre in 14: that 805, or 10 in every 100 enclosures, are between ½ an acre and 1 acre: that 1,347 are between 1 and 2 acres, being 2,152, or 27 in every 100 enclosures; more than a fourth being under 2 acres: 1,293 between 2 and 3 acres, being 3,445, or 43 in every 100 enclosures under 3 acres: 1,220 between 3 and 4 acres, being 4,665, or 58 in every 100 fields under 4 acres: 1,015 between 4 and 5 acres, being 5,680, or 71 in every 100 being under 5 acres: 743 between 5 and 6 acres, being 6,423, or 80 in every 100 under 6 acres: 511 between 6 and 7 acres, being 6,934, or 87 in every 100 under 7 acres: 357 between 7 and 8 acres, being 7,291, or 91 in every 100 under 8 acres: 231 between 8 and 9 acres, being 7,522, or 94 in every 100 under 9 acres: 148 between 9 and 10 acres, being 7,670, or 96 in every 100 are under 10 acres: 327 are upwards of 10 acres, being about 2½ in every 100 fields; or 1 field larger than 10 acres in every 113 acres; and making in all 7,997 enclosures. Thus it will be seen that whilst 87 in every 100 enclosures, are under 7 acres, only 13 in every 100 are larger than 7 acres. With such a disproportionate number of small fields the immense loss sustained may be still further shown by the following calculations, which I made from a great number of measurements, the average being taken. By the kind of hedges generally used, on fields of the first size given, averaging ¾ of an acre, the loss by hedges is 17 per cent; on fields of the second, between 1 and 2 acres, the loss is 12 per cent; by those of the third size, between 2 and 3 acres, the loss is 10 per cent; on fields between 3 and 4 acres, 7½ per cent; on fields of 10 acres it is about 4 per cent. The per centage of course varies very much with the shape of the field and the thickness of the fence; but by this it will be seen that when the fields average 10 acres, the hedges being of the same kind, the loss is only half of what it is when they are three acres and upwards.

The evils of the present system of dividing farms, general over this and great part of the neighbouring counties, may be thus summed up. The hedges occupy in some cases fully 10 per cent, but on an average of these ten parishes, 7⅐ per cent, or one acre in fourteen: they shade and injure at least half as much, most persons, landlords as well as tenants, whose opinion I have asked, say, *quite* as much more: they harbour birds and vermin which injure the crops; and that this is no small evil any one may satisfy himself, by going into a field just before harvest. They are nurseries for weeds: they prevent that free circulation of air so necessary to the healthy growth of plants as well as animals: they are obstacles to the drainage of the soil, the roots grown in them frequently choking up the drains. They are expensive to erect, as well as to keep in repair; the expense of new hedges in labour and planting being about 3s. 6d. per perch, and that of keeping them in order about 5 per cent of the rental: the soil on each side of them is generally thinner, from the materials for making the banks being taken from it. So many small enclosures require a much greater number of gates, which have to be kept up and renewed: they cause a much greater number of small lanes and cart tracks leading from one place to another. The damage from shade is also very much greater from those hedges which run east and west. To do the least damage and to be of the greatest service, as shelter, our most prevalent and severe winds being from the west and south-west, hedges should be made, and the long way of the fields be, from north to south; for the same reason that Loudon lays it down as a rule in building a house, to make the diagonal line in that direction; namely, because the sun thus shines on every side of it every day. The fences being in most cases crooked, and the fields of every shape but right-angled, the labour of every operation of the farm, particularly of ploughing, is most materially increased. The parishes of Huxham and Poltimore will contrast favourably with the others in this respect. This evil is any thing but a trifling one, especially when to it is added the labour caused by the roots of trees which shoot out into the fields. In any parish this is felt; but in such a parish as Rewe, where there is much timber, one may see, when the ground is laid open by the plough, that *the roots of the trees cross each other from opposite sides of the field.* These roots must abstract much of the nutritive qualities of the ground. As an instance of how fast the root of a tree grows, the following fact was mentioned to me by a gentleman of Crediton: —"A drain which had been made only the year before was found to be stopped up; and on examination the cause was discovered to be the root of an elm, which had grown into the drain more than thirty feet."

Having pointed out the evils of the existing system, I may be asked how it can be remedied, especially without marring the beauty of this county, to which these luxuriantly wooded hedges add so much. To this I would say that such a landscape gardener as the late Mr. Loudon, if asked to dispose of this timber in the most effective manner, would not have been likely to lay it out in long straggling hedge-rows, but in clumps, belts, and woods, which would serve for shelter and give the best effect. Fences could then be of a much simpler and inexpensive kind. Where stall feeding is practised there need not be anything lost by hedges; as I have seen farms without any fences but that which surrounded and divided them from the adjoining farms, a furrow being all that separated one crop from another. But even where this system is not adopted there are several methods whereby farms may be sufficiently divided, and the whole or greater part of the ground saved which is at present lost. Besides railings of wood, wire, or iron rod, there is the sunk fence; none of these taking up any land. In wet, marshy, or boggy ground, ditches would serve for fences and drains at the same time; and in such a place as Broadclyst Moor this method of dividing and at the same time of draining the land would very much increase its value. But in cases where it might not be thought advisable, either owing to the first expense of iron rod, or wire railings, or to other circumstances, to adopt any of these methods of dividing land, the white thorn would make a cheap and good fence, taking up very little room, being impervious to cattle, and costing little either at first or in keeping up afterwards. A thousand plants will plant thirty perches of one row, or fifteen perches of two rows, the plants being six inches apart: they cost from 10s. to 20s. per thousand, according to their age, and the planting of them is very little. Sir John Kennaway, by taking down 100 perches of bank and planting 50 perches of thorn hedge, thus making three fields into two, saved nearly an acre of ground. There is not any reason that I can see why a farm even so small as a hundred acres should lose more than one per cent. by its hedges. In a survey of a parish road which I lately made, with a view to its being widened, I found that, for the greater part of its length, its width might have been *trebled* by merely adding to it the space taken up by its present wide fences. John Matthews, Esq., of Clisthydon, has within the last few years taken down half of the fences on his estate, and is proceeding to take down nearly all that remain. Timber need not be encouraged in hedge-rows on account of its value, as, from the admission of foreign timber, this has been materially reduced. I should not think that the timber thus grown pays nearly so much annually as one per cent. of the rental, while it destroys about ten per cent of the ground; allowing 3 per cent. more than what is actually occupied, for injuries sustained by the causes mentioned. What necessity is there for a farm, even so small as a hundred acres, being divided into smaller enclosures than eight ten-acre fields, and the remaining twenty into four or five, as might be most convenient? It would be a great improvement on the present state of things, if, instead of six fields of every ten being under four acres, there were the same proportion above ten acres. If to the loss shown to be sustained from these small enclosures and great hedges were added that from waste ground and the want of drainage, how very far short of its capabilities would appear that which is at present derived from our soil. An eminent writer of the present day says, "The introduction of thorough draining will probably increase the productive power of the soil in Great Britain a third; scientific discovery may perhaps add another third: but at least ten years must elapse, in the most favourable view, before these effects take place,—ere the judicious and well directed labours of our husbandmen have formed rivulets for the superfluous wet of our fields, or overspread the soil with the now wasted animal manures of our cities."

Although I have shown the loss to be so great from the present system of dividing farms, I am not so sanguine as to expect to see anything like the saving made which might be, there being in some cases many difficulties to contend with; as where property is very much intermixed, and where it is leasehold; but with willing minds, and an enlightened co-operation of landlord and tenant, this county may soon become as famous for its superior farming as it is now for its mild climate and beautiful scenery. I have given several instances where much has been done in this neighbourhood; these, and the example of other districts at present in advance of this county, form examples worthy of imitation. If every agriculturist recorded the results of his experience, much knowledge of the most practical and useful kind, at present confined to himself and frequently dying with him, would be added to the general stock, and advance the science proportionably. The discoveries of Professors Liebig and Playfair: the improvements made by our Royal, Highland, and Provincial Agricultural Societies; and put into practice by Earls Ducie and Spencer, Mr. Pusey, and a long list of the great and intelligent throughout our island; have given an immense impetus to agricultural improvement; which I trust will not cease till our land has attained that full amount of productiveness which the Almighty intended, and which His kind providence has placed within the reach of every practically scientific agriculturist.

Dated Exeter, 243, High-Street,
22nd July, 1844.

W. Roberts, Printer, Exeter.

ON THE FARMING OF ESSEX.

PRIZE REPORT.

BY ROBERT BAKER,

OF WRITTLE.

LONDON:

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ON THE

FARMING OF ESSEX.

PRIZE REPORT.

Essex is exceedingly well situated as an agricultural county, not only from its neighbourhood to the metropolis, but also as being, upon nearly one half of its whole boundary, surrounded by the German Ocean and the River Thames, whence the inland navigation is materially advanced by the Stour, Colne, Blackwater, Crouch, and other rivers, intersecting or bounding it, and by an extension of the Blackwater, by the Chelmer inland navigation to Chelmsford; by the Colne to Colchester, as well as by the Stour (dividing Essex from Suffolk); by the Crouch to Battles Bridge, and by various canals from the Thames to Stratford and its vicinity.

Perhaps no other county has such excellent roads, not only turnpike, but even parish highways, which are almost equal to the turnpike roads in other counties.

The soil in Essex varies so greatly, that as much difference of system is required in its culture as between counties remotely situated. The principal substratum is chalk passing beneath nearly the whole extent of the county, and cropping out at Saffron Walden northward, and at Grays Thurrock, upon the Thames, southward, at which latter place are extensive lime works. Upon the chalk rests the London clay, a strong tenacious soil lying from 100 to 300 feet in thickness, also cropping out about three miles south-east of Chelmsford, and extending towards the south; upon which, diluvium consisting of beds of tenacious clay, loam, gravel, sand, and various other strata rest, either in beds uninterrupted for considerable space, or in every variety of admixture in the same field; in the valleys near the principal rivers fine alluvial soil abounds.

As the system of cultivation pursued upon these different varieties of soil differs so greatly, I shall divide them into classes, and shall mention various parishes and farms that come under each denomination of soil: conceiving that the system pursued in the cultivation forms the main intention of these essays.

Division of the County.

1st. Subsoil—chalky clay, with good depth of soil lying direct upon the clay, or upon beds of strong loam intervening.

2nd. Subsoil—chalky clay, or strong tenacious loam; London clay, or beds of gravel and sand in alternate veins, running for the most part from north to south, but near the large rivers parallel with the same; rich alluvial soil resting upon tender loam, absorbent.

3rd. Subsoil—London clay, with more or less of yellow clay, and sand in admixture with various loams forming the upper soil.

Rich alluvial soil, mixed with greater or lesser proportions of sand or gravel, forming those portions called the light lands of the county.

First, or Chalky-Clay District.

This comprises a large portion of the county, and taking Dunmow as the centre, extends to Cambridgeshire, Hertfordshire, Epping, and nearly to Chelmsford; although the general character is subject to occasional variation in parts of the district.

The parishes of Stebbing and Dunmow, together with all that district called the Roothings, are comprised under this head.

The system of cultivation that has been long pursued is that called the crop and fallow system, by taking fallow and grain crops in alternate years; or by what is termed the *four-course shift*, having equal proportions of fallow, barley, clover, peas or beans, and wheat in each year.

By the former mode.
First year—Fallow.
Second year—Barley.
Third year—Fallow.
Fourth year—Wheat.

By the latter mode.
First year—Fallow, with turnips or cabbages in small portions.
Second year—Barley.
Third year—Clover or peas, beans or tares.
Fourth year—Wheat.

This soil requires considerable attention in management, as it becomes tenacious and compact if trodden or ploughed whilst in a wet state, and does not recover this poaching (as it is termed) until again pulverised by frost. The nature of the soil almost of necessity precludes the growth of green winter crops for cattle, not from the soil being incapable of producing them, but because the damage caused to the land by removing them in winter is so great as almost to prevent their being grown to advantage; and it is only within a few years that the attempt has been made; but since early swede turnips and mangold-wurzel have become more frequent in cultivation on clay land, they have to some extent been introduced into these districts, and upon some of the soils of deepest staple succeed well; white turnips are also grown to some extent, and of late the cattle kept, which are few in comparison with those upon districts of lighter land, have advantages beyond their predecessors of the last century; for at that period barley-straw formed almost the only staple of cattle food from November to May, not only for neat stock, but for horses also. A better system of management is now generally introduced; the growth of root crops, the yard feeding of sheep in winter, and the consumption of green crops in summer, added to a system of burning the soil (now prevalent throughout the district), has, in many instances, changed the nature of the soil, and in no part of the kingdom can any be found that will make a greater return for high farming. The application of manure, whether from the farmyard or otherwise, increases not only bulk in straw, but quantity and quality also in the grain, and, from the retentive nature of the soil, manure continues to benefit for several years after its application.

The soil is, from the great quantity of calcareous matter it contains, particularly adapted for the growth of barley, which for quality and malting properties is not excelled by any in the kingdom. This barley is principally sold to maltsters at Stortford, Sawbridgeworth, &c., and is sold in London under the denomination of Ware malt, taking that name from Ware in Hertfordshire, a market town standing in a district of similar soil.

The wheat grown in this district is mostly of the coarser description, and is either the common red or brown wheat in all its varieties, or the revit or bearded wheat, of which there are also several varieties; the latter is of a coarse description, but more productive than either of the varieties of common wheat, and succeeds the others in ripening; it was at one period in repute for making a description of flour called "cowens," used by the bakers for making up their dough, and also by millers for mixing with other descriptions of wheat, as might be requisite in particular seasons, as from its lateness in coming to the sickle it has not unfrequently happened that whilst the earlier wheat has been affected by wet harvests, this variety has escaped, in which case it becomes valuable; the price it produces at market has also of late years approached nearer to the price of red wheat, and from being more productive in the proportion of one in five, the value of the description of land of which we are treating has been enhanced proportionably.

The varieties of red wheat principally grown are the Syer, golden drop, American, Burwell, Russell, and Smoothy; the two last are new varieties, having the character of some of the preceding. The Syer is a variety producing an abundance of straw. The golden drop, wheat with long and also very stiff straw, not easily lodged, and very productive in dry seasons. The Burwell, a variety of fine red wheat grown at Burwell in Cambridgeshire, from whence its name; and the Russell and Smoothy, a close compact-eared wheat of the American character, and also very productive upon the best descriptions of land. White wheat is grown of good quality, but only to a limited extent.

Peas are grown to some extent, and are frequently sown with oats as food for horses. This crop is denominated bullimong, and probably answers on some descriptions of soil; but the practice should be exploded, as the land cannot be so much benefited as it would be by taking the crops separately in proper succession.

Beans are not much grown, but upon the more heavy tenacious clay soils they are produced with success; whilst upon the chalk-clay subsoils, with thin staple, they do not succeed so well as peas; the latter also are grown in limited quantities.

Clover is grown only once in six or eight years, for if sown oftener, it is apt to fail in plant; and even when in plant it is not very productive, unless highly manured, which is done upon the young plants in the autumn; in that case it is mostly afterwards mown; but the usual practice is to feed with sheep through the summer, or to feed close until the 1st of June, when the stock is removed, and the clover is reserved for seed, producing from two to eight bushels per acre; four bushels may, however, be considered an average crop. The expenses attendant upon thrashing and preparing for market are so great as frequently to leave the producer a loser; these expenses being, upon an average, about 4*s*. to 7*s*. per bushel of 70lb. weight.

Tares or vetches are grown to a considerable extent, as the comparative scarcity of pasture land renders it imperative upon the farmer to produce artificial green crops as a substitute for grass in summer, and hay in winter, as well as for the improvement of the land by feeding with sheep or folding in yards in the summer months.

Small patches of pasture land (for the most part) only are to be found upon farms in this district; but in the vicinity of Ongar, Epping, and Harlow, nearly one half is of pasture, excellent in quality, though not productive in quantity. Dairying was formerly very prevalent in this district, but is now almost discontinued, the suckling of calves and grazing having in a material degree superseded it; but the butter, when produced, is of fine flavour and quality, and bears a high price in the London market.

The system of management pursued appears well adapted to the district, as abundant crops of barley and wheat are produced upon the system of alternate naked fallows; and although it may appear not so profitable, still when put into competition with the four-course shift, less difference, upon calculation, becomes apparent than might be at first supposed; this arises from the greatly diminished expenses of cultivation, as by a continuous system of farming upon this principle weeds become almost eradicated, and in many portions of the district under good management are hardly to be found in the eddishes, with the exception of the yellow charlock, which appears in the barley crop, and, in the spring, sometimes prevails so much as to render the fields one continuous mass of bright orange colour, undoubtedly injuring the crop, but certainly not to the extent that a casual observer would imagine.

The system as carried out is upon ridges of four furrows only, five of which ridges in width make about a rod, or 3 feet 3½ inches each. These, in the first instance, are what is termed sized; that is, if the land is harrowed or scarified down flat, the ploughman sizes them by going one bout, or by once going and returning up the field; which an experienced hand can effect with the utmost precision. The next operation is called four-furrowing; the ridge being ploughed in a neat compact manner with two bouts or four furrows: these, again, are either struck down with two furrows, as in the first instance, and again four-furrowed, or four-furrowed in succession, the tilths being given at intervals of about one month, and from three to four altogether during the summer; three and half (or twice four-furrowed, and three times struck or sized) constituting what is termed a clean summer's fallow.

The land lies in this state either (as it is termed) upon the round ridge ploughed with four furrows, or upon the flat ridge ploughed with two furrows, until the following spring, when in the month of March it is either scarified and drilled, or the barley is *sown* by three operations, and partly ploughed and partly harrowed in with a very light pair of harrows. Four ploughs and a pair of harrows, with one seedsman, will put in from five to six acres per day, and the neatness with which it is executed exceeds description, as upon an acre scarcely a clod of two inches' diameter can be seen, and the finest tilth imaginable is produced by the action of the frost during the winter.

When the scarifier is adopted, the drill becomes necessary, and as this mode in the majority of seasons succeeds best, it is now becoming exceedingly prevalent, as the land is not so likely to reunite should excessive rain succeed, nor so liable to be affected by drought should dry seasons follow. A saving is also effected in expense and seed; the former mode requiring four bushels per acre, but the drill requiring only three bushels per acre. The produce may be estimated from four to six quarters per acre, and five quarters may be taken as the full average crop of the district. The difference in expense by the two modes would stand as follows:—

First Mode.

	£	*s.*	*d.*
First year making the fallow, three whole tilths, and one strike, at 8*s.*	1	8	0
Two harrowings	0	1	4
Seed tilth	0	8	0
Harrowing	0	1	4
Seed, four bushels	0	16	0
Sowing	0	0	4
	£2	15	0

Second Mode,

By the scarifier, as follows:—

	£	*s.*	*d.*
First year fallow	1	9	4
Scarifying	0	2	9
Harrowing	0	0	8
Seed, three bushels	0	12	0
Drilling	0	2	6
	£2	7	3

Gain by latter process, 7*s.* 6*d.* per acre.

The barley is seldom interfered with until the following harvest, the clean state of the land not requiring the hoe, and the yellow charlock usually appearing in such quantities as to defy it; but by a perseverance for a succession of years in hand-weeding it out of the crop, it may be entirely eradicated, and has upon some farms belonging to and occupied by the owners been thus got rid of, but as leases are not sufficiently extended so as to repay the tenant his expense in effecting so desirable an object, it is seldom attempted.

In the third year the same routine of fallowing again takes place, and the wheat is ploughed in beneath the furrow, and left without harrowing, an operation effected at so little expense as to put those lands beyond comparison in that respect with any others in the kingdom, as the whole operation of ploughing and putting in the seed does not exceed 8*s.* 9*d.* per acre; the quantity of seed mostly sown is 2½ bushels per statute acre.

				£.	s.	d.
Brought down making fallow				1	9	4
Seed tilth	0	8	0	0	8	9
Sowing and preparing seed	0	0	6			
Water-furrowing, &c.	0	0	3			
Weeding				0	1	0
2½ bushels of seed at 50*s*. per qr.				0	15	7½
				£2	14	8½
Add two years' rent	1	16	0	4	4	0
Rate	0	8	0			
Rent-charge	0	10	0			
Harvesting with beer	0	12	0			
Thrashing 4 quarters at 3*s*.	0	12	0			
Marketing and carriage	0	6	0			
				£6	18	8½
Brought down	6	18	8½			
Incidental fencing, windrows, &c.	0	5	0			
Draining 3*l*. per acre for 14 years 10 per cent.	0	6	0			
Interest of capital, 2 years	0	12	0			
	£8	1	8½			
Produce of 4 quarters				10	0	0

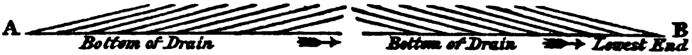
Leaving 1*l*. 18*s*. 4*d*. for implements, wear and tear, assessed and property tax, and for 2 years profit.

It is usual after the fallow in the fifth year to introduce clover, which is sown either at the time of sowing the barley, or about one month afterwards, at the time of rolling the land with a light roller, to make the surface smooth for the better enabling the mowers in the succeeding harvest to mow off the crop evenly; the clover is usually fed with horses and sheep, and, from the absence of other pasture, frequently with cows and other neat stock. Upon the better descriptions of land the clover is mown for hay, but upon the poorer soils the crop is of the meanest description, the stalk of the clover becoming of a dark purple colour, or, as the farmers term it, "red-shanked;" and upon such lands the crop is almost valueless, as neither sheep nor horses will eat it readily, as it is supposed a bitter flavour is imparted from the soil, to which they have an utter aversion, and will starve in the midst apparently of plenty. Tares, both winter and spring, are grown for green food, but are considered not to improve this description of soil, making it so light and porous that neither wheat nor barley succeeds well after them. Beans are sometimes taken, and peas at this time, and upon the land most suitable (such as has sufficient depth of staple) succeed tolerably well. The estimate upon the best lands cannot, however, be taken at more than 32 bushels per acre, and upon the inferior lands at about 18 bushels.

The routine of farming presents so little variety upon soils cultivated upon this system, and the active management is reduced into such narrow limits, that during the winter months it very little engages the attention of the farmer beyond that of merely attending to the thrashing and marketing his grain, and carrying out his draining, which, however, requires his close inspection, for unless this department is well looked to (being task-work), the labourers will not execute it properly; and instead of benefiting their employer, will for the sake of the trifling difference in wages that they can thus obtain, produce more mischief than they effect good. The best mode is to let the cutting of the drains by task-work, for which from 2*s.* 6*d.* to 3*s.* 6*d.* per score rods is paid; a confidential man is employed to fill and complete them, for which he is paid by the day; but upon small occupations this department is undertaken by the farmer himself, or his sons, who attend in the afternoon, and, after having seen that the drains are properly cut, commence filling them with wood and straw. It is presumed draining has been carried on in this district longer than in any other part of the kingdom, evidence of its having been practised for upwards of one hundred years being found from old entries of labour paid; but the supposition is that it has been in use from about 1700, that is, nearly 130 years after Tusser published his "500 Poyntes of Husbandry," in which work he makes no mention of the practice. The process as carried out is simple and effective, and of little expense in comparison with that practised in other districts; several methods are prevalent, of all of which sufficient notice will be taken to show their comparative merits.

The oldest and still most prevalent mode is by ploughing out the drains transversely to the ridges, or rather diagonally of the field, taking care to give them sufficient fall or draught for the water. They are usually ploughed parallel to each other at distances varying from 5 to 7 yards apart, those soils where the greater quantity of chalk abounds not requiring them to be so near to each other as where the stiffer loam prevails. The ploughman first opens his work with a larger and stronger description of plough than the common foot plough used in the district for ordinary purposes; this he does by ploughing out four furrows, commencing on the outside, leaving what is called a baulk in the middle, which is also ploughed out by two furrows more; the plough is then brought back in the bottom of the last ploughed furrow, and by one or two operations a depth of 6 or 8 inches is obtained. Sometimes a second plough is used of peculiar construction, having a narrow ground and light breast, which takes out the last furrow clean; the next operation is to plough out the leaders or main drains at the lowest end of the transverse drains, and an opening to about every 100 rods of common drain is made into the ditch surrounding the field (which it is necessary to have well made previously to commencing the operation); these necks, as they are termed, to the main drain or leaders are cut into the open ditch, on whichever side of the bank it may happen to be: the workman then proceeds to dig out the main drain, which he does with a spade about 10 inches long and about 3½ inches wide at the point; a boy follows with a small shovel and casts out the loose mould; after having completed a few rods, he is followed by another drainer, or he returns and with another spade longer and narrower than the last cuts out the next spit or lower part of the drain, either leaving a shoulder or not on each side, as may be required; but for the ordinary mode of filling no shoulder is left, but the drain is cut with the utmost precision, not perpendicular but slanting about 3 inches; the drain is cleaned out with a scoop, termed a hoe, and when the drainer arrives at one of the drains that enter the leader, he commences upon it by necking it in, before taking out all the soil on each side of the point of intersection. This he does to prevent the edges being broken down by the operation, and thus proceeds with all the drains successively, taking care not to open more of the main drain than he requires to enable him to proceed with the cross drains. The main drains are usually dug out to a depth of 22 inches, and the cross drains 20 inches beneath the ploughing, so that their depth is about 26 and 30 inches respectively. After his work has proceeded, so as to enable him to fill in with the materials necessary, which consist of wood covered with straw, or with thorns and straw, or straw alone, either twisted into long bands or not, or, in the absence of either, stubble gathered from the field; but the work is considered best done when proper wood is selected, of which the common hazel-nut wood and sallow are best, or thorns that are long, clear, and straight; he then commences at the point where he left digging, and puts in the wood compactly and neatly at the bottom of the drain, cutting it into proper lengths, and weakening it "with a cut half through at the crooked parts so as to enable him to fill" the drain about 3 inches high, keeping the largest wood at the top and pressing it down closely piece by piece with a small crotch-stick, the ends of the last put in lengths lying upon those put in first, so that the whole may gradually overlap the last, as at B, that running water may meet with no obstruction by the ends of the pieces of wood meeting it, which would be the case if the filling commenced at the part first dug. The workmen prefer the latter mode, and unless watched closely will adopt it, as it gives them less trouble; but an inspection of the two modes in the annexed diagram will show the superiority of the first-described plan:—

Position of wood.



Course of the water from A to B.

After the wood is placed, the straw, which should be long and straight, is placed upon the top about 3 inches thick, and firmly trod down by the workmen passing along upon it, putting it down at the sides of the drain, with both hands at the same time, which he effects as he walks along. The drain is then filled in with the soil that was taken out, unless it is stiff, tenacious loam, which is cast aside and supplied by the upper surface-soil; but if the soil is white chalk-clay, it is best to put it direct upon the straw, as it forms an arch more substantial than soil of a porous quality. Some persons have the wheel of a heavily loaded cart drawn along the drain, whilst others condemn the practice altogether; but my own observation has led me to approve of the plan, unless the soil should be of an extraordinarily stiff character. Care should be taken to put larger wood at the ends of the main drains, so that they may be afterwards easily found; and to prevent rabbits, moles, rats, and other vermin destroying them, which they will do unless great care is taken to prevent it; but the better plan is to fill them for about 3 feet with 2-inch earthen pipes, by which security is obtained against such accidents.

Other methods are prevalent, and one most in use is by having a piece of wood, about 6 feet in length and three inches in depth, and made to fit the bottom of the drain in width; this is wetted, and placed at the bottom of the drain, upon which the soil taken out is rammed to the thickness of 3 or 4 inches. By the assistance of a lever attached to a chain fastened to this plug, as it is termed, it is drawn forward as the work proceeds, and thus a hollow drain is left, equal to about 3 inches diameter, which answers extremely well upon sound chalky clay soils, but should never be adopted upon very stiff loams, as the ramming of such descriptions of soil would cause it to become so compact as to prevent the water finding admission into the drains at all. These two methods are more prevalent than any others, and indeed are almost the only ones adopted in this district; and, if well executed, will continue to act well for fourteen or twenty years. It is necessary that the drains should be cut transversely with the stetches, to prevent the horses, during wet seasons, treading them in, which they most certainly would do if the drains were cut in the direction in which the horses walk during the ploughing of the land.

Another system is introduced with excellent success; viz., by the windlass mole-plough, which presses out a drain, of about 2½ inches in diameter, at 12 or 14 inches below the depth ploughed; exactly as for the spade drains. So the leaders or main drains are mostly dug as before described, and filled with wood and straw, and are made either before the ditches are mole-ploughed or not; but it is most important to have men to work upon them during the same time the ploughing is going on, for should heavy rain fall before the main drains are cut, it would destroy the ploughed drains altogether by the deposit that would be left after the water had drawn off. A mole-plough drawn by twenty horses is also used; but the windlass mole-plough, from its steady action, and requiring but two horses, succeeds better. Drains effected in this way are found to run well for ten to fourteen years upon the chalk clay, but upon loamy soils they soon close in, by the loam, after a short time, again uniting and filling up the drain.

The cost of the two operations differs so much in amount, that the latter mode is superseding the former to a considerable extent—very much depriving the labourers of winter work, which was provided in a great measure by the former mode.

The cutting and filling the drains 22 inches deep costs from 3*s*. to 4*s*. per score rods; but, probably, on sound clay, not exceeding the former sum. About 8 score rods are put in each acre; this, at 3*s*., would be 24*s*. per acre; if wood and straw are used, about 24*s*. more; but if thorns or haulm only, about half that sum. The labour in cutting drains, and for hire of mole-plough horses and driver's time, will not exceed 15*s*. per acre for the same quantity of drains. The charge for the man and plough is from 8*d*. to 12*d*. per score rods, or about 6*s*. per acre over and above the additional sum for the horses' time and for cutting the main drains.

When the land is regular in descent, and all the drains run in one direction, the better way is, in the second ploughing of the fallow, to put the stetches in the direction of the drains, and to make them of the same width as the drains require to be from each other; thus nearly all the labour may be saved of ploughing out the drains, and again ploughing them in after the operation, as the merely ploughing of the stetches will effect that object in the ordinary way; care should, however, be taken always to plough over the drain as soon as it can be done, for in the event of heavy rain falling the drains would be injured by the soil washing into them; and care should be taken to prevent the drains uniting with the main drains at less than an angle of 60°, as the accumulation of soil carried down by the water would be prevented escaping when the drains are first made, and probably spoil them altogether.

The process of burning the soil for purposes of manure being peculiar to this district, it will not be out of place to give a description of it here.

Two methods prevail—the one the burning in large masses, and the other in small heaps; and two descriptions of soil are collected for that purpose, the one consisting of the green strips of uncultivated land lying round the sides of arable fields, which are dug up in spits, about 8 inches in depth, and partially dried by the sun and air before burning; by the other, the whole surface of the field is ploughed up, with as thin a furrow as possible from a grass, sainfoin, lucerne, or other layer, upon which a large quantity of vegetable matter has accumulated, this, being partially dried by exposure during summer, is collected into heaps containing about 4 square perches, and by a process peculiar to the district is burned so as to be reduced about one half in bulk; the ashes and unconsumed matter being carefully spread afterwards as manure for the succeeding crops. The labourer commences by placing some large pieces, by which he frames an artificial furnace, open to the windward side; he then places some dry stubble and ordinary wood or thorns upon the top, and partially covers with some of the driest of the collected earth; the fire is then applied, and as it progresses the whole is speedily covered with the earth, and by degrees the remaining earth is applied; taking care not to allow the fire to burn through to the external surface of the heap without applying a fresh supply of the earth, and at the same time avoiding laying it on too thickly, so as to press down the heap closely in the first instance. With attention and assistance, many of these fires are kept burning at once, night and day, until the whole field is gone over; and, with proper skill and attention on the part of the workmen, very little escapes the action of the fire in the first instance, but should any escape it is collected and carried forward to the next succeeding row and there consumed. It is difficult to burn the earth collected from around the sides of fields in the same manner, and the heaps are therefore increased to a larger size, the same process only being necessary of constantly applying fresh matter wherever the fire is seen bursting through, for should that be the case to any extent, unless fresh wood is applied and relighted, the fire of the whole soon becomes extinguished. The objection to burning in large heaps arises from the strength of the fire being so much increased as to burn the earth *red*, and sometimes almost as hard as brick. Attempts have been made in districts where gravel is scarce to burn it for the purposes of road making, but the action of the frost soon reduces it to its original state, so as to make it in the end totally useless, unless a coating of gravel is afterwards applied.

The advantages attending this process have long been canvassed by agriculturists; the objections taken by landlords and their agents are, that by continual repetition it reduces the staple of the soil, and by concentrating the salts and other matter enables the tenant to avail himself of all their fertilizing properties at once, to the injury of his successors; but on the other hand it is contended that, as the application of the system enables the tenant to produce excellent crops of vegetables upon a soil where none were originally grown, he is enabled to keep an increased quantity of stock, and thus more than repay by manure what he had exhausted by the fire. It is not the intention here to discuss the question, but to state a few facts that elucidate the point; the process undoubtedly when carried on in small heaps does not waste the soil as much as when in large heaps; the direct advantages are the destruction of the coarse vegetable matter it contains, thus preventing the injurious effects from wireworm and other insects, by killing their larvæ, the production also of a clean surface, and the being enabled at once to bring the land into cultivation for rape, turnips, mangold-wurzel, and cabbages, all of which succeed well after burning without the aid of farm-yard manure. The land to which the ashes are applied becomes for several years afterwards more easy to pulverize; and the first grain crop succeeding the application is frequently increased in quantity and quality 20 to 25 per cent. Barley certainly partakes of the benefit more than any other crop, and the clover generally succeeds well afterwards.

These are all advantages; and as to the disadvantages they cannot be met better than in the statement of Mr. Litchfield Tabrum, formerly of High Roothing, Bury, an extensive clay-land farm: for upwards of twenty-five years the system was carried out by him in the most perfect manner, and the sums paid for labour were very great; but from the fact of the number of sheep and neat stock being increased six-fold at the latter portion of his term, and the productiveness of the farm so greatly increased as to induce the succeeding tenant to give a very considerably increased rent, we may infer that the advantages far outbalanced all those objections raised against its practice; and from the high eulogiums passed upon the system by Mr. Tabrum, and the success that attended his exertions throughout, added to his afterwards carrying out the same process upon his succeeding occupation with equal success, no one acquainted with him, or the facts attendant, can doubt of the benefit to be derived from his course of practice: other experienced farmers in the district, of whom Mr. Saltmarsh, of High Easter, stands most prominent, carry out the system with the same advantages. One point I omitted to mention is, that the quality of the barley as well as quantity is considerably improved, and 2*s*. per quarter is the lowest estimate at which such improvement can be calculated; the soil containing a large portion of chalky matter is partially converted into lime, potash too is formed from the combustion of the inert vegetable matter, and other salts are generated, conducive to the increased production of crops of vegetables and grain. The cost of producing this manure is less than that of any other description equally beneficial to the land; it is produced upon the spot where it is required without the expense of carriage, and the whole outlay does not exceed in any case 40*s*. per acre. The burning into ashes is paid for either by the cubic yard or at so much per heap; for digging and burning 5*d*. to 6*d*. per cubic yard of ashes is paid, and in some cases 7*d*.; for burning in heaps of 4 perches each, of which there are forty to the acre, 8*d*. per heap, and the use of a horse, or donkey, and cart. Upon land containing a greater proportion of silica the cost is increased, as the waste is greater than where pure clay abounds, as each heap will then contain about 1½ to 2 yards, and 60 to 80 yards will be given to each acre: when carted on from large heaps from 40 to 50 yards per acre are usually applied, but this depends upon circumstances; when applied for turnips the ashes are sometimes spread in drills and ploughed in as other manure. It has been suggested and proved that if the finest portions are sifted from the coarser, and drilled in with the turnipseed, the crop will be more benefited than by adding a larger portion in the ordinary way. Some farmers combine the ashes with bone-dust and other artificial manures with decided advantage; and setting all other considerations aside, the process assuredly induces a clean system of culture, and finds much useful employment for the labourers, not the least important consideration at this time.

The live stock kept in this district varies with the opinion of the respective occupiers; and from Essex being but in a limited degree a breeding county, all the varieties of Welch, Scotch, and homebred inferior short-horn cattle are found. In this district especially, the Welch breeds are preferred and used; as cows they are considered better adapted than any other kind. The polled Suffolk cow is also kept, and is well adapted for either dairying or for suckling calves for the London markets. These calves are brought from London and other dairying districts when about 7 days old, and are sold from 15*s*. to 40*s*., and sometimes as high as 45*s*. each; they are usually kept on milk alone for 10 weeks, leaving a profit of about 4*s*. 6*d*. per week in the summer, and from 5*s*. to 5*s*. 6*d*. in the winter months; but of late the trade has been greatly depressed and the profits materially reduced. A cow is considered to pay well if she produce a net profit of 8*l*. yearly; but unless the pastures are good few reach that amount, as the suckling-calves have lately been bought in at a much higher rate than formerly.

The fattening that is carried on is effected with the help of mangold-wurzel and swedish turnips; but second-rate animals are, for the most part, usually fed, being kept upon straw and a few turnips the first winter, grass in summer, and sold off in the autumn, or fattened in the early part of the ensuing winter.

The sheep are principally Hampshire Downs, with some Sussex Downs, and half-bred Down and Leicesters, but the former answer best and are most extensively kept. Wether lambs are purchased in the autumn and are kept either in the yards or pastures during the winter, and in the ensuing summer either folded upon the fallows or fattened upon the clover; in the former case they are sold in the ensuing autumn or winter, fed upon turnips, oil-cake, or beans. Hampshire Down ewes are kept on small farms for producing early lambs for the London markets, and the ewes themselves are also sold for the shambles in the autumn; the average cost of the ewes per head being about 24*s.*; the return, including the wool and lamb, from 50*s.* to 55*s.* Lambs are purchased at about 18*s.* each; and if fattened from the clover, produce about 30*s.* to 32*s.* each, including the wool; those sold for stock realise about 25*s.*, inclusive of wool; but as by the management alone the profit may differ from 20 to 30 per cent., no estimate but a general one can be given. Breeding sows and swine are kept upon most farms, and are of the Essex variety, known as the half-black breed; but not of that description introduced as the Essex breed by Lord Western and Mr. Fisher Hobbs (these, being of modern introduction, have not become prevalent at present); but a larger description of distinct black and white colour, the space over the shoulders being, for the most part, white, with full hanging ears, excellent mothers and prolific, producing from eight to fourteen at each litter, which grow quickly, and at three months old are sold for the London market and large distilleries; at ten months old they average about 180 lbs. each.

The implements used in this district are not peculiar; cast-iron foot-ploughs with wooden beams and handles, in using which the horses are driven abreast with hemp-reins, or by the voice of the driver; in some instances wrought-iron shares are still in use; the ploughs for the most part being lighter and narrower than those used in the other districts of the county. The ploughmen are very expert, and have no difficulty in performing the work to the amount of a full acre per day. In the spring months from 1¼ to 1½ acres are usually effected upon the fallowed lands; the labour to the horses being at that season of the most trifling nature, and those best calculated to walk quickly are selected as best adapted to effect the work.

Common harrows made with wood, and iron teeth, are most prevalent, not only here but throughout the county. They are extremely small, so that six of them form a set, being fixed together with iron couplings and attached to long or short whippletrees, by a chain and swivel; two of these harrows cover a single ridge of four furrows; four cover an eight-furrow stetch, consisting of two ridges bouted into one; and the six covering the three ridges ploughed as one stetch of twelve furrows, each ridge being 3 feet 3½ inches, and each harrow being only 1 foot 7 inches wide, having two sides running parallel with four or six cross-bars united to the sides with a tenon inserted into a mortice.*

Rollers peculiar to the district are used, the one a small-bellied roller about 4 feet long, without a frame; the other a similar roller, double the length, with a frame; the first is used for rolling four-furrowed ridges, and the latter eight-furrowed ridges: the common roller peculiar to the other parts of the county is of different dimensions; the double roller with joints, to enable the horses to walk in the furrow, and having one shaft fixed to each roller, is of modern invention, and supersedes both the other descriptions upon stetches of all sizes and of different planes, as the roller, from being attached by joints adapts itself, as it proceeds, to every description of stetch it passes over.

Root-ditching, as it is termed, is prevalent throughout this district; this is performed by cutting a drain about 20 inches in depth, parallel with the banks round the fields, about 10 feet from the hedges; by thus dividing the roots that protrude from the trees, great injury to the crops is prevented; otherwise, in dry seasons especially, they affect the crops to an astonishing degree for several perches from the fences, especially where ash-timber abounds. Here, however, pollard oaks, with now and then a clump of elm and ash thinly scattered, are the extent of our timber. The fences are also weak, with low banks (thence the repute as a hunting district), of which the live portions are principally blackthorn and hazel. Fences more recently planted consist of whitethorn quick, placed upon the face of the bank in single or double rows, with a ditch in front from 4 to 5 feet in width; those fences are closely cut about once in eight years; and of part of the materials is formed a hedge after the ditch has been scoured out and the soil placed upon the top of the bank.

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* An objection, however, exists as respects harrows made upon this construction, for, from the sides throughout being parallel, and a space being allowed for each harrow to work independently, the tines are apt to leave the edges of the furrows uncut in straight lines; this is obviated by increasing the length of the foot-chains of each harrow gradually from side to side of the whole width, and, instead of being fixed at the middle of the front bar, each is fixed more towards one side than the other, by which the harrows, when drawn forward, move diagonally, and thus more fully effect the object of thoroughly pulverizing the surface.

Upon some of the thin-stapled lands of this district sainfoin is grown with success, and affords excellent crops for hay for several successive years of from 20 to 35, or even 40 cwt. per acre; the process is, late in April to drill upon the same land on which barley has been sown about 5 or 6 bushels per acre of new seed, which is generally done acrossways of the stetches; the sainfoin comes on in the following year, and after the crop of hay is taken, produces an abundant second crop, which is fed with cattle and sheep. It is necessary to the produce of this crop that the land be thoroughly drained, and that it have a top-dressing in the autumn, of which coal or wood ashes, or soot, are said to be superior to farmyard-manure; it succeeds well upon all land having chalk or chalk clay as the subsoil, and is a great acquisition to farming in districts where lands are too poor for clover and artificial grasses.

This division, comprising fully one-fourth of the county, is important as a wheat and barley growing district. The soil is more certain as to an average annual return, being less affected by either wet or dry seasons than most other districts, and in the latter producing crops good in quality as well as quantity. Many portions are cultivated at as little expense as in any other district in the kingdom; but from the crops being produced only in alternate years, and the quality of wheat being coarse, *less profit* is derived than from more fertile districts.

The amount of wages throughout this district ranges from 2*s*. to 3*s*. lower per week than in many other districts in the county. The labourers' cottage-rents are, however, fully 1*s*. per week lower than elsewhere; and, for the most part, larger gardens are attached to the cottages. Flour of a coarser description is eaten, and some privileges are enjoyed as regards fuel, which makes the difference not so great upon comparison as it appears at first sight—the wages at the present moment being from 8*s*. to 9*s*. per week; poor-rates from 3*s*. 6*d*. to 4*s*. per acre (3*s*. 9*d*. may be taken as the mean); surveyor's rates, 10*d*.; church-rate, 2*d*.; tithe rent-charge from 5*s*. up to 6*s*. per acre; rent from 15*s*. to 22*s*. per acre (the average certainly below 20*s*. per acre). Throughout this district, the farm premises are ill arranged: large barns, sheds, and waggon-lodges, being placed inconveniently, and detached from each other—the accumulation of water from their thatched roofs falling into yards having large hollows and excavations made by constant scooping out the clay from time to time as the manure is carted out, so that a person unacquainted with their inequalities is liable to be engulfed in them, as the surface, being covered with the accumulated barley-straw, exhibits *all smooth* to the eye; and it is only by the rising of the water and sinking of the straw that he is awakened to the situation he is placed in. This, however, has been remedied by the more spirited occupiers, but still prevails to an extent deserving their attention, as, upon a moderate estimate, one-fourth of the most valuable properties of the manure is thus annually lost.

The farm-buildings are commonly timber-built, and thatched. The external walls are either common weather board cut from elm timber, or clay daubing upon lath—the clay being suited to this kind of work and very durable, and when whitened over with lime having a neat appearance; the white gable-ends of the buildings and houses shining in the sun's rays give vigour and relief to the landscape.

Second or Mixed Soil District.

I shall now proceed to the second or eastern division, comprising all that portion described as consisting of gravel, with beds of loam, chalky clay, and alluvial and diluvial strata, in successive order or abruptly displaced.

I shall commence with the land lying upon the banks of the Chelmer, which, to an extent of about 2 miles northward and southward, may be taken as a tolerable specimen of the other portion lying upon the Stour and Colne, and extending from Colchester to Harwich.

The tender loam or brick earth subsoil, lying nearest the river, is in some instances uncommonly fine, and well adapted for the growth of almost every description of vegetable and grain crops.

The higher portions of Danbury, Baddow, Tiptree, &c., constitute a division remarkable for its abrupt varieties of subsoil, consisting of strong clay, gravel, sand, loam, and beds of pebbles lying alternately in successive strata in the same field.

This portion of the county is remarkable for its fine timber, the hedgerows abounding with elm, oak, ash, and maple; but from the fields being small they cause incredible damage to the crops by their roots extracting the nutriment, and shading them from the sun, compensating only by the beauty afforded to the landscape by the multiplicity of tints and variety of foliage displayed.

The beauty of the country, as viewed from these elevated points, is unsurpassed by any other in the kingdom; and the salubrity of the air contradicts the opinion that Essex is an unhealthy county, portions of it alone having been liable to that accusation, and those portions being now rendered healthy by the drainage that has been effected, as well as by the abundance of fresh spring-water which has been procured from artesian wells.

Rich meadow land abounds upon the banks of the rivers, but the quantity requisite towards the proper cultivation of the arable land is *below* rather than *above* the average; still the defect is well supplied by artificial grasses. Many portions of this division are farmed in a very superior manner: many farms, almost entirely arable, maintain a sheep to every acre the greater portion of the year, with bullocks or cows in proportion of from 5 to 10 to every 100 acres during the winter months. The system of bare fallows is almost exploded in this district, except upon the heavier descriptions of land, unfit for the growth of turnips or green crops. The prevailing system will be best described by stating the rotation and application upon a farm already in cultivation, commencing after the wheat crop has been taken off.

Immediately after or during harvest the stubble is collected unless the wheat has been mown, and the land receives one, two, or more deep ploughings, if time allows, and if the soil be gravelly. Rye is sown upon a very fine tilth, produced by more than one ploughing, and sown upon the surface or drilled fleetly, and lightly harrowed in; or if the soil is loamy, tares are sown, mixed with either rye or winter oats, or both. The rye is partly mown for horses and cattle early in the spring, being cut into chaff with proportions of hay and straw, and a part is fed off with sheep; the land being further improved by carting mangold-wurzel on the field to feed with the rye, with the addition of oil-cake or other artificial food. The land is again quickly ploughed once or twice, and well scarified. A crop of swede or white turnips is then taken, half of which is usually drawn, and the remainder fed off with sheep; and the land is either ploughed, and sown with wheat, or remains, as most usually is the case, until the following spring, when it is either ploughed or scarified, and drilled with oats or barley. The clover is sown with this crop, and is either mown for hay, and the after-crop fed off with sheep, or fed early, and left to stand for seed, or fed altogether through the summer with horses, pigs, and sheep; or, in lieu of the clover, peas or beans are grown, which are hoed well as long as weeds can be extracted without injury to the crop. If clover has been taken, it is ploughed up in October, and the land sown, dibbled, or drilled with wheat, which is carefully weeded, and reaped or mown at the following harvest, when the same mode of cultivation is repeated; or the land receives a partial fallowing in the autumn, and is sown with mangold-wurzel. This is succeeded by barley or oats. If clover was taken in the previous course, beans or peas are now taken, and wheat succeeds; and oats sometimes follow, if the wheat has succeeded clover: thus by alternating the crops, giving frequent ploughings and manuring, a regular succession is kept up of green cattle crops intervening with the grain crops, giving the greatest possible return from the land, but certainly not without a corresponding outlay in labour.

The usual system, however, is what is termed the four-course shift, which, in eight years, will stand thus—sometimes, however, oats are taken after wheat with good success, and are allowed in the covenants of leases to the extent of one field only—

1st. Turnips,
2nd. Barley,
3rd. Clover,
4th. Wheat,
5th. Mangold-wurzel or Swedes,
6th. Oats or Barley,
7th. Peas or Beans,
8th. Wheat.

If oats are taken in succession after wheat it would be done in the fifth year, and the course of cropping would then proceed as described.

The probable result will be, upon well farmed land, as follows:—

1st.	Turnips..............	manured	15 to 24 tons per acre.
2nd.	Barley................	„	40 to 48 bushels per acre.
3rd.	Clover................	„	1⅓ to 1¾ ton per acre.
4th.	Wheat................	„	28 to 32 bushels per acre.
5th.	Mangold-wurzel	„	20 to 30 tons per acre.
6th.	Oats..................	„	48 to 56 bushels per acre.
	Barley................	„	40 to 48 bushels per acre.
7th.	Peas or Beans (precarious)	„	28 to 32 bushels per acre.
8th.	Wheat................	„	28 to 30 bushels per acre.

This would be the probable result upon good farms with high cultivation; upon second-class farms, 4 bushels less of wheat, 6 of barley, and 8 of oats would be grown; the average of the district may be taken as the mean between the two quantities.

A covenant of lease and custom prevails not to allow clover to be mown twice in one year. This should be exploded, as the land is not injured by two mowings; and if the hay from one crop is expended, it is more than equivalent in return of manure than if the whole was fed by sheep.

Little can be offered, in a general description of the cultivation of a county or district, beyond that of merely stating the system of cultivation carried out by the best farmers, who, from long experience and practice, in most instances succeed better than a stranger who introduces a new system; for it happens that strangers rarely succeed so well as those who from their youth have been identified with a particular locality. This is especially true as regards this county, as very few farmers from distant counties, who have come under my notice, have succeeded here. And so it is as regards winter fatting; upon the clay and retentive soils it is very true that fine crops of turnips can be very frequently produced, but this is always at the expense of a large quantity of manure; and the injury done to the land by carting off, or by treading heavily with sheep during the winter months, and more especially by suffering crops of turnips, rape, cabbages, or other food of like nature to remain late upon the land, for the use of early-lambing ewes and other stock, does deteriorate it to such an extent as nearly to exhaust the manure for the next crop, which is exemplified sometimes by a portion of the field remaining in fallow and producing crops 20 per cent. better than that from which the green crops have been taken.

To obviate this should be the especial care of the farmer; and perhaps in no other county in England is the mean so well preserved. From the soil being variable, some fields upon every farm are not adapted to the cultivation of turnips, whilst, on the other hand, mangold-wurzel may be produced with less expense, and is more valuable both in the quantity and quality of the food; and as this root is much cultivated, it will not be out of place to allude to the system pursued in its cultivation before we proceed further. There are three varieties of this valuable root generally in use: the long red, having a long clear root, growing from 12 to 18 inches in length, of a pale red colour, and bright green leaves, with beautiful veins of red; another variety of red, similar in colour but of a globular form, tapering downwards and approaching near to the shape of a turnip, with leaves exactly similar to those of the long variety before described; a third variety is like the last in shape, but of a pale orange colour, with lighter coloured leaves, and orange coloured flesh. There is also a long variety of this colour; but from being less productive than the red varieties, it is not grown extensively.

In comparing the merits of the three varieties, much depends on the quality of the soil upon which it is grown; for upon the heavy clay lands, and in dry seasons, the long kind is by far the most productive variety, but upon lighter soils the globe succeeds best; and in the experiments made by the writer in several seasons, upon weighing the roots the proportion was as follows, and with very little variation as to the number of roots in the different seasons:—

	lbs.	lbs.	lbs.
90 roots of Long red upon the square perch in rows 2 feet 4 inches apart	475	435	536
83 roots Globe red, ditto	435	400	375
92 roots Globe orange, ditto	375	330	436
Long orange, ditto	415	375	

These experiments were made, in successive years, upon good sound wheat land, with tenacious subsoil of strong loam lying upon chalk clay, well drained and manured; seasons moderately moist.

The process of cultivation pursued is, after the crop of wheat or barley is cleared, to plough up the land immediately, and give two or three deep ploughings and harrowings before the winter. The land is then put upon small ridges from 2 feet to 2 feet 6 inches wide; but the size usually adopted is such as to allow the cart-wheels to pass up two furrows without injuring the ridges. The land is suffered to lie in this state until the following spring, unless a suitable opportunity offers to carry on the manure in the winter months during frost, and afterwards plough it in. If this is not accomplished, and the weather permits, one ploughing or more is given in the spring before carting on the manure, unless the land should be in a sufficiently clean and pulverized state from the previous ploughings and harrowings given before the winter. The quantity of manure applied is about 18 loads, of 30 bushels each, of good compost that has been partially reduced, so as to be easily ploughed in. If the manure is not sufficiently decomposed, the roots do not succeed so well during drought, should it ensue in the following summer. After the manure is carefully spread in the bottom of the furrows, the land is ploughed, lightly rolled, and the seed* either dibbled or drilled as soon after as can be, and again lightly rolled, unless the weather should be very moist, when it is considered best to leave the drills only lightly covered. In dibbling as well as drilling care should be taken not to deposit the seed more than one inch in depth, putting it in either with a small dibble, or by pressing it in with the thumb and fore finger alone, at a distance of one foot apart, and inserting from two to three seeds in each hole, and filling the holes by punching the soil in with the back of a hoe. From 3*s*. to 4*s*. per acre is paid for this, and if well performed, a plant may be almost insured.

The drill is, however, preferred as more expeditious and certain, especially in dry seasons; as, from the seeds being contained in a hard capsule, from three to five in number in each, and from being deposited thickly in the row by the drill, a plant is more certainly obtained, and the plant can be left more regularly, in a majority of cases, than when dibbled. Mice as well as wireworm are very destructive to the seed and young plants, and a larger proportion is therefore the more necessary to ensure success. The plants also grow more rapidly when they come thickly; therefore not less than 3 lbs. of seed should be deposited upon each acre, care being first taken to ascertain that the seed has not been previously destroyed by mice, which is sometimes the case, and which an inexperienced eye would not detect.

As the plants appear, the greatest attention should be paid to keep them clear of annual and other weeds; and as soon as they have reached from 2 to 3 inches in height, they should be singled out, leaving the largest plants at each place at distances of at least 1 foot apart. The ridges should then be well hoed, and the furrows horse-hoed, and at each repeated hoeing the earth should be drawn by the hoe from the roots, until, by the end of the summer, the ridges will have become level. Early in November the roots should be pulled and the leaves twisted off, care being taken not to leave them exposed to frost after pulling, as the portion extracted from the ground would, in the event of a single night's frost occurring, be so much injured as to rot after being collected.

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* The time of sowing is from the beginning of April to the middle of May.

The roots are either stored in outhouses or in buildings having thick external clay or brick walls, and thatched, or put into a row or clump about 8 feet in width, and brought up to a point, placing the crowns outwards (when finished similar to the roof of a house), about 5 feet high, and then covered with straw and earth, leaving the top open for some time to allow the heat arising from fermentation to escape.

I have been the more particular in describing the culture of this root as practised, from its importance as an article of food for cattle and sheep in the later spring months; for, unlike every other vegetable at that period, it continues to improve in quality during the whole time it is kept, and is most in perfection in the months of April and May; nor should it, if possible, be used before February, after vegetation has commenced, as, from that period, the root has a more beneficial effect upon the animals to whose use it is applied. The quantity grown is from 20 to 30 tons per acre; the cost of cultivation may be estimated as follows:—

Labour, &c.	£.	s.	d.
3 deep Ploughings,	1	7	0
3 Harrowings,	0	3	0
Making ridges,	0	6	0
Carting and labour to manure,	1	0	0
Manure,	2	14	0
Ploughing ridges,	0	6	0
Rolling,	0	1	0
Drilling,	0	3	0
Seed,	0	4	0
Singling, 2*s*. 6*d*. and 4 hoeings, 15*s*.,	0	17	6
Pulling, carting, and stacking,	0	15	0
	£7	16	6

The rent and other charges bringing it very little under 10*l*. per acre.

The process pursued to obtain this root upon the heavy clay lands of best quality is not nearly so expensive. Upon a clean wheat eddish, the manure, in a green or raw state, is carted on in October; the land is then ploughed once only, and in the spring is scarified, and the seed drilled, the same process as in the other case being afterwards pursued.

The system pursued to obtain swede turnips is carried out exactly the same upon the heavier soils, the ridge-culture being best adapted for that description of root. The ridges, however, are narrower, but the process of manuring, &c., is the same: the seed, from 2 to 3 pints per acre, is drilled from the first week in May to the middle of June; the more gravelly the soil the later the seed is put in. It is especially necessary that the seed should be deposited immediately upon the furrows being turned, and the moisture secured by a light roller. The latest sown turnips are almost invariably the best in quality; and, provided the land is in sufficient tilth and well manured, the first week in June is sufficiently early for sowing. The roots are pulled before Christmas, carted and stored, or are collected in heaps and consumed, wholly or in part, upon the land, either by fatting sheep in the winter, or by ewes and early lambs in the spring. The customary plan is to cart one moiety wherewith to feed stalled or other oxen, and to feed the remainder upon the land from troughs, after having been sliced, in addition to oil-cake, in quantity of from one half to one pound each per day, giving them the oil-cake in the morning with some cut chaff, or reserving a part for the night.

The cost of producing an acre of swede turnips will stand as follows:—

	£.	s.	d.
Four ploughings, ...	1	16	0
Four harrowings, ...	0	3	0
Once scarified, ...	0	4	0
One ploughing for manure on ridges, .	0	6	0
Manuring as before, ...	2	14	0
Labour on ditto, ...	1	0	0
Ploughing on ridge, ...	0	6	0
Ditto repeated, ...	0	6	0
Hoeing twice, ...	0	10	0
Pulling, ...	0	6	0
Carting and storing, ...	0	16	0
	£8	7	0

This appears a large sum; but the fallowing and cleaning apply to the crops through the three succeeding years, from the same field, to the growth of which the turnips also conduce in a material degree.

The system of drawing half, and feeding the remainder with corn or oil-cake, is decidedly the best management on this soil, as a good crop is taken from the land, and the feeding the remainder is equivalent to a dressing of the best manure.

When, however, feeding is intended, the turnips are drilled upon the wide stetch, such being always the case upon light land; the sheep are not so liable to loss from being cast in the furrows, and the land retains the moisture better upon the latter system than upon the ridge-culture. The crops of turnips suffering severely in dry summers in this district, the utmost care is requisite to guard against drought.

White turnips are grown exclusively upon the light gravelly and sandy, as well as dry loamy land, and are sown from the 12th to the 25th of July. A finely pulverized soil is necessary, and manuring highly, to produce a crop. The hoeing taking place in the harvest month is more expensive, and seldom costs less than from 10*s.* to 12*s.* per acre. As many as eight ploughings are sometimes given before this crop is put in, and rarely less than six or seven. The whole crop is mostly consumed by cows and sheep; but from its liability to injury by frost, is precarious, and is generally grown as an auxiliary to other turnip crops; the produce from 500 to 800 bushels per acre.

The common drum head cabbage is grown for sheep, as also the thousand-head cabbage for spring feeding. These are mostly planted in large ridges manured with 20 loads per acre; from 6000 to 7000 plants per acre are transplanted in June, the cabbages weigh from 10 to 30 or even 36 lbs. each; the average weight may be taken at 12 or 15 lbs. each. The last-mentioned varieties are used during severe frost or snow, and are mostly consumed by the flocks and neat stock.

White carrots have been grown in limited quantities hitherto, but from the experiments made, are most abundant in produce, upwards of 30 tons having been produced to the acre; the cultivation however is exceedingly expensive, and the obtaining a plant very uncertain.

The new artificial manures have hitherto been used to a limited extent, nor has their introduction been attended with those results that were anticipated;—the soils of Essex are not so capable of deriving advantage from bone manure as those of Norfolk and Suffolk, and but little advantage has arisen from its application.

In the early part of this report, connected with the growth of root crops, the proportions of arable and grazing land were adverted to. The excess of root cultivation upon any farm is not attended with such profit, as when moderately carried out. Upon farms of 200 to 300 acres of arable, from 50 to 60 acres of fallow are made,—about one-half or 2-3rd parts of this is applied to the growth of root crops: by so doing, a better division of the labour takes place, as by growing tares, &c. The making the fallows upon that portion is best effected in the latter part of the summer, whilst the fallowing for the early turnips requires the full force of the farm to prepare the soil for their reception; and also as regards the manure, a portion can be reserved for the grain crops; and the successful result of a well filled stack-yard is better secured by having some clean fallowed lands for barley, as well as by giving a better opportunity to eradicate couch or twitch grass, and other root-weeds, especially thistles, so prevalent in the soils of this county; and whatever theorists may affirm to the contrary, it is impossible to farm land so profitably in any other way, as by devoting a portion to thorough-draining and fallowing in each summer: the land is invigorated by the continual exposure to the air, and will produce as much under this rotation as can be produced by any other mode, however expensively it may be carried out. The writer of this article has through many years made, as well as seen, repeated experiments to supersede fallows entirely with green crops, but believes it as impossible to succeed without them upon this soil, as for the animal powers to be kept always in full operation without sufficiency of time allowed for their renovation.

The subsoils of Essex perhaps are more prolific of root-weeds than those of many other counties, chalk excepted. The common thistle, the bind-weed, or, as it is termed, sheep-bine, a species of thistle, called gut-weed, and couch or quitch grass, exist in the subsoil to a degree, that it is absolutely necessary, for their eradication, that an exposure in summer, by repeated ploughings and scarifyings, should take place, and this can only be effectual in the early spring and summer months whilst vegetation is rapidly proceeding; and although much may be effected in the autumnal months towards their eradication, it cannot be effectually performed after the grain crops are removed: the roots having at that period become hardened, and containing more woody fibre, and the sun daily losing power, the moisture is retained in a greater degree, so as to baffle the efforts of the farmer to eradicate them. The succession of grain crops, in alternate years, is of sufficient frequency to ensure success, and to allow the land to be kept up to its producing point; and as upon lighter soils excellent crops of turnips can be obtained upon the fallowed land, equal in value to the inferior grain crops, no other system, I am convinced, can be adapted better to the cultivation of these descriptions of soil than that which is at present followed and is secured by conditions in most of our leases.

The expending of the turnips in many instances is imperfectly carried out; and it is upon the larger occupations only that they are turned to the best account, either by sheep-feeding one portion upon the land with corn or oil-cake, or by consuming the remainder in yards with bullocks or cows.

Stall-feeding, however, is carried out upon the larger farms with great spirit, but unfortunately, of late, with little profit;—the great advance of price that has taken place in lean stock (especially that of a superior character), and the depression upon the meat markets, has so reduced the profits, as to have rendered it impossible for some time past to stall-feed oxen with any advantage to the grazier.

The system pursued is to purchase lean animals at the autumnal fairs in our neighbourhood; the Scotch and Welch varieties, Herefords and Durhams, are generally selected. Welch cattle are usually kept the first winter and spring upon a small quantity of turnips given in fold-yards with straw, are then fed upon grass, and finished with turnips in the early part of the ensuing winter. The Scots, especially the polled galloways, are either stall-fed in houses or in yards; and, with proper management, are fattened in about four months. The turnips are mostly sliced, and about 3 bushels of swede or 4 bushels of white turnips, with the addition of 5 lbs. of oil-cake per day; and during the latter portion of the time the oil-cake is increased to 7 or 8 lbs. to animals weighing from 80 to 100 stones of 8lbs. And the cost of bullocks of this description has varied from 10*l.* to 12*l.* each, which have been sold out at from 15*l.* to 20*l.* each. The usual calculation was for the bullock to double its value, and then it was considered fairly to repay the expense and trouble taken to produce it. The Hereford variety is much appreciated, especially heifers, which are purchased forward in calf, which having fattened, they are then put forward themselves, and are frequently sold within the year.

As Essex is not a breeding county, it may be expected that every variety of stock should be found in it, which is really the case; the smaller farmers generally keep the inferior varieties, consisting for the most part of the Welch or Irish breeds. The Highland varieties are grazed upon the marshes the first year, and are mostly finished off in the second with turnips, or mangold-wurzel and oil-cake. The Galloway Scots, Shorthorns and Herefords are stall-fed the first winter.

Cows of every description are kept, but short horns have only lately been introduced on the best pastures. Suffolk polled cows are greatly approved, and the North and South Wales varieties, upon the farms of inferior or heavy quality of land. The produce of a cow is estimated at about 8*l.* per annum for suckling calves, and 12*l.* for dairying.

Labourers are plentiful throughout this district; and as the harvest commences earlier than in the north-western district, harvestmen proceed from thence and assist in this division for a week or fortnight, so that it is not unusual for farmers who have capital at command to reap all their wheat crop in the first week of harvest. Although reaping has been the general practice, it has of late given way to mowing with a common scythe cutting towards the standing corn, not only on account of the increased quantity of straw obtained, but also from the land being left clean for the cultivation of the succeeding crop, without the necessity and expense of first cutting and carrying the stubble. Little fagging or bagging, as it is here termed, is performed except in the vicinity of the metropolis, where it is practised with some success.

The ricks are mostly made square or oblong, and are placed upon frames with stones or iron piers and caps; but little skill is displayed in the setting them up, and the neatness of the ricks in other counties puts those of Essex in the background. The price of reaping varies according to circumstances; the average may be taken at 8*s*. per acre, with one gallon of ale and one of table beer in addition. Harvest work is done either by the month or at so much per acre; allowing each man from ten to twelve acres, the amount given in money varies from 9*s*. to 11*s*. per acre, producing 5*l*. as the compensation; the labourers receiving, in addition, eight pints of ale, or six pints of strong beer, and four of table beer per day. In some cases malt is given to the amount of three bushels, and 4lbs. of hops to each man, with the use of brewing utensils and casks, and from one to two meals, exclusive of the horkey or harvest-home supper, during the month.

If the weather proves fine, the labour is mostly performed within the month; but sometimes wet weather protracts the harvest, to the great injury of the labourer as well as of his employer.

Oats are generally mown, and if stout are placed in bands, and suffered to lie exposed for a day or two without binding; they are then bound, and mostly put upon stacks to prevent the liability of their being heated; but more generally they are suffered to lie in swarth until ready for carting. A general error in management is prevalent as regards this crop, which is frequently suffered to remain so long as to allow the best portion of the grain to shed, to the extent sometimes of six bushels per acre. Oats should always be cut before they are quite ripe; the straw is improved thereby so as to become nearly as valuable as hay; and the late oats, if left by the thrashers adhering to the straw, usually come into account when properly applied to the feeding of stock or cutting into chaff: the average produce may be taken at 6 quarters per acre. The black tartarian are considered the most prolific, and are more generally grown than any other variety; the straw, however, is inferior to that of any other kind; all the varieties of white oats are also grown with success, of which the Dutch brew is considered the most productive.

Barley is invariably mown, and in wet weather is much exposed; it is, however, considered best not to turn over the swarths, but merely to lift them lightly, and to leave them upon what is termed the outing, made at the commencement of the preceding swarth by the mower putting his scythe in a sloping direction downwards, leaving the stubble higher, which prevents the barley from coming into contact with the earth, so that it is thus not so easily sprouted. The average crop of barley in this district may be taken at 5 quarters per acre; for although here and there a piece may be found producing in good seasons from 7 to 8 quarters per acre, this is not of frequent occurrence.

Beans are grown on the heaviest descriptions of soil. They are an excellent preparatory crop for wheat; and Essex is notorious for their excellent culture, as such is the nicety pursued in hoeing them that, where well managed, scarcely a weed can be found after the last hoeing is given. The seed is either drilled or dibbled, the latter effected by the man using two dibbles, and walking backwards with children following to deposit two beans in each hole. Sometimes, but not frequently, they are dibbled by a single dibble, the man dropping the seed as he proceeds.

Dibbling with two dibbles can be done at a lower sum per acre than by any other mode; from 4*s*. to 5*s*. per acre is the usual price, and with a single dibble 4*s*. are paid; but they are not so thickly deposited, neither are the rows so near together. The drill is very frequently used, and for small-sized beans as well as peas is an admirable implement, but hardly ever succeeds so well as dibbling well carried out. This crop may be taken at from 3 to 5 quarters per acre; but upon heavier and more tenacious soils double that quantity is frequently grown.

The cost of cultivation of the bean crop may be taken as follows:—

	£.	*s*.	*d*.
Dibbling	0	4	6
One ploughing and harrowing .	0	11	3
Three clean hoeings . .	0	12	0
Reaping	0	8	6
Carting	0	2	6
Thrashing 4 quarters . .	0	7	0
Marketing and carting out .	0	6	0
Seed, 3 bushels . . .	0	11	0
	£3	2	9

As a preparation for wheat no other crop is considered so beneficial excepting clover.

Peas, grey, white, and blue, are extensively grown; they are mostly drilled after the barley crop, and thus become, like beans, the intervening crop between the barley and wheat crops. They are usually drilled in rows 9 inches apart, with about 3 bushels of seed to the acre, and are generally hoed twice, at an expense of 6*s*. per acre. The produce is uncertain, but in good seasons will be from 4 to 6 quarters per acre. The former quantity may be taken as a full average crop. The expenses will stand as follows:—

	£.	*s*.	*d*.
One ploughing	0	9	0
Three harrowings . . .	0	2	3
One rolling	0	1	0
Harrowing	0	0	6
Hoeing	0	4	0
Ditto	0	2	0
Cutting and harvesting . .	0	9	0
Thrashing and marketing . .	0	12	0
Seed	0	12	0
	£2	11	9

Garden peas are extensively grown for the London seedsmen, who find the seed, and pay from 40*s*. to 50*s*. per quarter for the produce (1844), after again deducting their seed. This is a very precarious mode of cropping, as the peas so grown are frequently a delicate or dwarf variety, and are consequently more hazardous to obtain a full plant than of the grey peas or other long-straw varieties; and also suffer the weeds to rise amidst the crop, thereby injuring the land to an extent that frequently overbalances the difference obtained in price.

The wheat crop may be variously stated; but, taking a succession of years, 30 bushels per acre may be considered an average crop.

The wheat-plant is mostly hoed by hand, at an expense of 4*s*. per acre, in March and early in April. The cost of harvesting is about 10*s*. 6*d*. per acre, which, with the ale, amounts to 1*s*. 6*d*. more; thrashing by hand from 2*s*. 6*d*. to 3*s*. 6*d*. per quarter; and the straw binding of 36 trusses to the load, and 36 lbs. to the truss, for market, 1*s*. to 1*s*. 6*d*. per load.

Clover seed, both Dutch and red, as well as trefoil, are grown in this district with success. The quantity of the former may be taken at from 3 to 5 bushels to the acre as an average crop, and of the latter from 6 to 7 bushels per acre. Wheat generally succeeds it, but not so well as when the clover is mown for hay, the late period of sowing giving opportunity to the slug, which frequently destroys the plant of wheat altogether.

The poor, highway, and church rates average about 5*s*. per acre; the tithe rent-charge about 6*s*. per acre, and the wages of agricultural labourers from 10*s*. to 12*s*. per week.

Thatching is paid for by the square of 100 feet, upon buildings from 4*s*. 6*d*. to 5*s*. are charged for labour only requiring about 20 trusses to the square.

The labourers pay high rents for cottages; from 3*l*. 10*s*. to 5*l*. per annum are paid, and even more in the vicinity of large towns, without the advantage of gardens, and sometimes with insufficiency of room. Excellent cottages, however, are common throughout this district, and are built chiefly of brick, or lath and plaster, containing three or four rooms of about 10 or 12 feet square.

The quantity of waste land is limited, but is good in quality, might be easily brought into cultivation, and would be of especial benefit if enclosed and cultivated.

Upon the whole the north-eastern part of Essex may challenge competition with the best farmed districts in the kingdom; and although great variation of soil takes place upon every farm, the farmer turns this to advantage by producing crops suited to all his purposes. He has ground adapted to the growth of turnips, mangold-wurzel, cabbages, tares, grasses, lucerne, and every description of grain upon the same farm.

The farm-houses and buildings are for the most part substantial, and ornamented with neat gardens and choice evergreens tastefully planted and maintained, and upon some estates a great outlay has taken place in this respect. Buildings in brick and slated throughout in the most substantial manner, have been erected at an expense beyond the mere capabilities of the estate to repay. The estates of the late Dr. Cline, Lord Petre, Sir Henry Smith, and others, have excellent specimens of buildings in the modern style; whilst numerous instances are to be found of buildings of older date improved so as to render them everything a tenant requires or could even wish for.

The buildings are mostly situated adjoining to excellent roads, and much care has been taken from time to time to make the farms upon large estates complete by an exchange of lands. The proportion of pasture is, however, small; but excellent artificial pasturage is produced for one or two years, and, so far, is more productive than the old grass lands; but after that period it becomes of little value for several years, until at last the natural grasses have arisen and become fully established. The seed usually applied is the Pacey and Italian rye-grass, mixed with white and red clover and trefoil, and in some cases sheep-plantain.

The Italian rye-grass is of modern introduction, but such are its qualifications and superiority over common rye-grass, that it bids fair to supersede it altogether upon the better descriptions of soil. All other varieties of rye-grass remain inactive, from the time of the first feeding or mowing, until the succeeding autumn; but the Italian rye-grass is not only much earlier, more productive, and better liked by the cattle, but it shoots quickly after being fed or mown, and advances so rapidly that two crops of seed can be taken in the same summer, or it can be fed until the middle of May, and a crop of hay or seed be afterwards taken. Inoculation by turf to procure permanent pasture has been practised with the utmost success; and when turf can be obtained is decidedly the least expensive mode (taking the immediate advantages into consideration): the remote benefit is beyond all comparison, as pasture is at once obtained equal to the old pastures in the district. The operation is simple, and the mode of producing it so easily understood, that a little explanation will enable any one readily to effect it. The land selected is usually that which has been previously fallowed and manured, and from which swede turnips or mangold-wurzel have been taken, the time selected being early in November. The land, being first reduced to a level and well-pulverized surface, is ploughed as the work proceeds by what is termed back-striking, so as to enable the work to proceed without carting upon the late-ploughed soil. Turf that has been taken up by a plough from a good pasture of similar quality, cut into small pieces about 1 inch square, is then deposited at equal distances, leaving a space about 3 inches apart from centre to centre. This is either stamped down with the heel or with a rammer; and, when all is disposed, is rolled with a heavy roller, and the work is complete. Some persons sow grass-seeds and clover in the following spring; but it is considered by those most experienced not advisable. The turf of itself will spread better if no intervening grass is present, and will, if properly carried out, at once form a permanent pasture. Some, however, dibble in wheat or oats; and sufficient may be grown to defray the whole expense; but it is questionable if the grass will proceed so well; it is, however, but fair to state that this has been the practice of the writer, and with the fullest success. The pasture from whence the turf is taken will be but little injured if a light covering of earth mixed with lime or dung be spread, and harrowed across so as to fill the interstices from which the turf has been carted, which consist of long stripes about 2½ inches wide, and from 2 to 3 inches in depth. Mr. Wedlake, of Hornchurch (the late spirited inventor and improver of agricultural implements), invented a complete apparatus, consisting of a plough and machine for cutting the turf into small pieces, so as to cover more space:–

These implements are still manufactured by his widow, of whom they may be obtained. The cost of inoculation may be taken at from 40*s*. to 50*s*. per acre, which must depend upon the distance of carting the turf, &c.

The rent of land in this district varies from 20*s*. to 30*s*. per acre; in the vicinity of London and near towns it is far above that amount. The rich marshes by Plaistow let from 4*l*. to 5*l*. per acre, and the arable land from 2*l*. to 3*l*.; but, as the object of this essay is rather to generalize than to particularize, the rent may be taken at 25*s*. average upon such lands as are adapted solely to farming purposes. The tithe is for the most part commuted into rent-charge,* and varies from 5*s*. 6*d*. to 6*s*. 6*d*. per acre, and rather falls below than exceeds that sum. The tithe compositions from 5*s*. to 6*s*. per acre. Poor rates 3*s*. 6*d*.; surveyor's rate 10*d*.; and church rates 2*d*.: making 4*s*. 6*d*. per acre altogether, inclusive of the county and police rates, which are invariably paid from the poor rate. The new poor law has effected a decrease of poor rate equivalent to about 15 per cent. in some parishes, whilst in other parishes, especially those situated in populous districts, it has increased; but, upon the whole, the working of the bill has been beneficial upon the labourers, in producing more order and regularity, and by generally improving their habits; and from having become more independent of parish assistance they are generally more assiduous and attentive to the interests of their employers.

Field cultivation is but little carried on in this district by women; during the summer months they are engaged in hoeing and weeding; in some particular instances they are employed in drawing turnips in the autumn, and in potato planting in the spring. The usual amount of their wages is from 6*d*. to 8*d*. per day, for which they work about as many hours; but when sufficient men can be obtained, their employment is limited, except in the vicinity of London, upon the garden lands.

Third, or Heavy Clay District.

I now proceed to treat of the third division of the county, comprising the Dengey Hundred district, as well as all the heavy clay lands lying towards the south-east, resting upon a subsoil consisting of London clay, exceedingly retentive of moisture, and of expensive cultivation, but, under proper management, producing excellent crops of wheat, beans, and oats.

This land is farmed, for the most part, upon the six-course shift of husbandry, except upon the poorer descriptions; there the four-course, as before described, is adhered to; the only difference in the mode being, that, after the wheat crop has been taken, it is succeeded by beans, which are thoroughly hoed and cleaned, and again sown with wheat. The rotation will be better understood by describing it throughout:—

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* By a recent examination of twenty parishes, the average rent-charge is found to be a little below 6*s*. per acre.

1st. Fallow.	4th. Wheat.
2nd. Oats.	5th. Beans.
3rd. Clover.	6th. Wheat.

Barley is sometimes grown upon the best and driest lands, and, since the introduction of chalk largely into the soils, with good success.

The first and leading principle in the cultivation of this land is carried on by the application of chalk.* This, in every instance, upon the first application, effects an astonishing change in the soil, enabling it to produce valuable crops for many years afterwards, without the assistance of any additional manure; but as nearly all the land has been already chalked over, it is now applied as an adjunct to other manures, and to render the land porous, and less tenacious; and from the facility with which it can be obtained by water-carriage, is, either as chalk or lime, in constant application upon all well-cultivated farms.

The expense of cultivating this description of land is very great. Three powerful horses are used for several of the first ploughings upon the fallows, and frequently upon land for corn crops. The horses are large and fine, yet two of them, with much extra food, are still unable to effect more ploughing, upon the average, than three-fourths of an acre per day. The horses require the best description of food to enable them to perform their work; and as much as 3 bushels of oats and beans are allowed weekly, with good cut clover hay; and taking the limited quantity of work performed, with the extra cost of horses and keep, into consideration, the expense of horse labour is increased fully one-third over that of any of the other districts.

The fallows are attended with immense expense, having frequently eight clean ploughings, and in no case less than six, some of which are effected with three horses, and are ploughed to a depth of five or six inches. The estimated value of the ploughings is not less than from 10*s*. to 12*s*. each per acre, with scarifying or crab-harrowing with four horses between the ploughings, besides a great deal of cross-ploughing, each time, to the numerous water-furrows, which average from 20 to 40 perches per acre, and are dug out with a spade at a cost of 10*d.* to 1*s.* per score rods, whenever the land is sown with wheat; and the stetch-furrows, at a distance of every 7 feet, are also ploughed out deeply after the corn is sown, so as to effect a ready passage to the water from the surface, as it has been found difficult to render land of this description dry by under-draining, on two accounts: one of which is, that the land is so tenacious that it is impervious to the water unless the drains are made with cockle-shells or shingle, with or without drain-tiles or pipes below the shells; the other is, that the soil, in dry summers, shrinks to such a degree as to form wide fissures or cracks from 2 to 3 feet in depth, and thus destroys the drains altogether. The system, as pursued by surface-draining, apparently fully effects its object, as excellent crops are produced, unequalled by any others in the county.

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* The chalk is carried at from one to four or five miles' distance from the water. About fifteen cart-loads are considered a full dressing per acre. Each load, containing 40 bushels, costs 6*s*. at the wharf: and for carting one mile costs 3*s*. 6*d*.; two miles, 5*s*.; three miles, 6*s*.; and so on, for any greater distance. But the expense precludes its being used at more than five or six miles from the water: at a greater distance lime is substituted, at the rate of two waggon-loads per acre; each load costs 32*s*. at the kiln.

The prevalence of couch or twitch grass in these lands renders it difficult to farm them without clean fallows at least once in six years, as it is impossible to eradicate it by short fallows, since it extends to such a depth in the subsoil as to require very deep ploughing to reach it, which deep ploughings would not be necessary for the crop alone. It is customary of late to drill the land that has lain through the winter exposed to the pulverizing effects of the frost without an additional ploughing, by first scarifying the surface, and then drilling in the barley or oats, for which operation a scarifier peculiar to the district is used, that is admirably adapted to the purpose. The lands scarified are considered to resist weather better, as well as drought, should it follow; and the crops are decidedly superior than from ploughing, without entailing that expensive operation upon the occupier.

Clover generally succeeds well if plants can be obtained, but the difficulty in that respect is even greater on this land than upon others in the county, and has of late rendered the returns from the wheat crop considerably less on that account.

The wheat grown in this district is of excellent quality, and with genial seasons very productive; but the uncertainty of a full plant, either from prevalence of black grass, or the destructive effects produced by the slug, in a great measure counterbalances its productiveness. From 1826 to 1832 the slug had been so destructive that a vast proportion of the tenants were ruined, and many of the farms fell into the landlords' hands. From 1832 to 1842 a succession of good seasons followed, but the crop of the latter year was almost destroyed by the wet seed-time and winter, and some farmers barely obtained a return of their seed. I mention this to show the precarious nature of these lands, although they do in some seasons produce from 40 to 50 bushels per acre, under favourable circumstances. The average growth, however, cannot, in my opinion, be taken higher than 34 bushels per acre. The variety of wheat grown is the white velvet, or rough chaff, which is especially adapted to the soil. Red Syer and the golden drop, as well as all the varieties of white wheat, are grown with success, but the rough chaff forms the principal growth. It is not long, but stiff in straw, and is not easily lodged; and the quality is superior to that of any other description, and invariably produces (with the exception of Talavera wheat) the best price in the market, frequently weighing 66 lbs. per bushel.

The bean crop is a most important one in this district, and perhaps in no other part of the kingdom are such fine crops produced. The management is also excellent. The beans, for the most part, are dibbled by a man with a single short dibble, so as to enable him to make the hole and deposit the beans (two in each hole) as he proceeds, following the plough as each furrow is ploughed; three men thus completing the work of one plough every day. As soon as the beans are well above-ground, they are harrowed, and afterwards well hoed. Two more hoeings, at proper intervals, mostly complete the operation. This is done at a cost of about 12*s.* per acre. The beans are cut in harvest, and tied with yarn tyers or straw bands, and frequently yield from 7 to 8 and even 10 quarters per acre. The average will perhaps fall rather below 5½ quarters per acre than exceed that quantity, as the seasons affect this crop almost equally with wheat. Horse-hoeing is partly applied, and in some cases successfully, but it is considered with little reduction of expense.

Oats come next under consideration, which are, in congenial seasons, very productive. From 7 to 10 quarters, and even more, per acre are frequently grown. The average, however, cannot be taken at above 7 quarters, and this upon the fallowed lands. Barley is grown in limited quantity, but abundant crops are sometimes produced upon the fresh chalked lands, being also of excellent quality. The usual proportions of tares and some peas are produced; but as beans supersede the latter they do not come under especial notice. Upon the lighter soils, however, excellent crops are produced.

The crops peculiar to this district are white and brown mustard, coriander, canary, and caraway, of which notice will be taken separately. Mangold-wurzel has of late been introduced, and very fine crops are obtained.

White mustard is sown broad-cast as early in the spring as it can safely be, so as to prevent injury from frost, and is generally sown upon land in clean order, and having abundance of tilth; one hoeing is given, and but little is afterwards required in its cultivation. The annual weeds and surplus plants are hoed out, and the crop is cut and harvested in the field, the produce being from 30 to 40 bushels per acre.

The brown mustard, once so prevalent in these districts, is mostly prohibited being sown by the covenants of leases; for if once sown it becomes a fixed tenant, and further impoverishes the soil; and whatever the succeeding crop may be, it usurps a dominion—sometimes to such an extent that the bean crop has been sacrificed to its prolific growth. Upon first broken-up land it is still attempted, the first crop frequently nearly realising the fee-simple value of the land upon which it is sown. As it is almost prohibited from cultivation, it will be needless to advert to it further.

Coriander and caraway are grown extensively in this district. The mode of cultivation being particular, it will be remarked upon, especially as the cultivation of coriander, in connexion with caraway and teasel, is rather singular, and merits notice. It was formerly the plan to sow a treble crop, of which teasel formed one, and was harvested in the second year; but since the introduction of a substitute by machinery has taken place in the woollen manufacture, its use has been much dispensed with, and it has consequently not of late been introduced into Essex cultivation. About the beginning of the month of March the seeds of the coriander and caraway are sown in the proportions of from 10 to 12 lbs. of the former to 12 or 14 lbs. of the latter—the land being previously well harrowed, and the seed afterwards well harrowed in; and here some difficulty presents itself in the management. The caraway-seed is very much smaller than that of the coriander, and as the practice is sometimes to sow before well harrowing, it then becomes deposited too deeply; but should the land be, on the other hand, in very full tilth, by sowing *after* well harrowing, the coriander-seed may not be sufficiently covered by the harrowing; and it is therefore suggested that the coriander-seed should be first sown after harrowing, and the caraway drilled after the process of harrowing has been partly carried on. In about eight or ten weeks the plants will be strong enough for hoeing, which it is important to complete as soon as possible. They will require about four hoeings, one of which is given at Michaelmas, and cost, with harvesting, about 50*s*. per acre. As it is necessary this work should be carried out by workmen who well understand it, they are therefore better paid than men in ordinary cases: besides, it requires especial care, and occupies much time to execute the work properly. Workmen are to be found who undertake the labour and divide the profits with the farmer, allowing him the rent as a deduction; and he, upon the other hand, finding horses to perform what work is necessary. Perhaps no crop is more variable in price and quantity than this, varying as it does from 7 to 20 cwt. per acre, but from 10 to 12 cwt. is considered a good crop. The coriander is also equally productive and precarious, varying from 6 to 20 cwt. per acre, and prices ranging about in the same proportions. It is therefore not surprising that some individuals have realised their fortunes by the cultivation of crops of this character. In the harvesting, great care is requisite to prevent the seed shedding in the field. To remedy this, cloths are used to receive and convey it to the thrashing-place, which is always in the field. The crop is liable to injury from late frost and caterpillar, and is therefore very precarious.

Canary is also much grown in this district. It is sown in April, and produces about the same quantity per acre as wheat. The thrashing is expensive, but the straw and chaff are much approved of for horses and cattle. The price is exceedingly capricious, varying from 40*s.* to 80*s.* per quarter. Canary is usually sown in the place of barley or oats, and is considered to pay, upon an average, from 1*l.* to 2*l.* per acre more than either of those crops.

The islands of Essex, upon the south-eastern coast, being composed of rich and deep alluvial soil, as well as portions of Rochford Hundred, are well adapted to the growth of the last-mentioned crops, as well as of every other kind of grain.

That portion of the county comprising Rochford Hundred is reputed the most fertile; but to it unfortunately, as well as to Dengey Hundred, a prevailing idea is attached of an unhealthy character—a considerable breadth of marsh prevailing throughout the whole district. Ague at one period ravaged it; but such has been the effect of cultivation and drainage, added to an abundant supply of water by what are termed artesian wells, that this portion of the county has of late become almost as healthy as other parts on higher elevations. The supply of water, by means of the wells alluded to, is obtained by merely boring through the tenacious London clay from 100 to 300 feet, until the chalk stratum is tapped. Pipes are introduced as the work proceeds, and the water immediately rises to the surface, and continues to flow—giving a supply not only to the homestalls of farm premises, but, by keeping it up in the marshes during summer, contributing a benefit to the grazier of incalculable amount, and has in a great degree rendered that portion of the county healthy.

The woodlands are extensive, but the produce has materially fallen in value during the last twenty years. The introduction of foreign timber in buildings, and of iron and network for folding sheep, has diminished the demand for poles. The supply of coal by water-carriage has also so much reduced the produce in value that unless an abundance of timber prevails few woods afford a rental exceeding 8*s.* per acre, whilst the greater part do not yield half that amount; and as the tithe commutation has now fixed the sum to be paid, it is presumed a large proportion will be grubbed in a short space of time.

One great drawback to cultivation arises from the small enclosures, added to the great number of timber-trees and pollards in the hedgerows. In small enclosures, under 5 acres, the deterioration that ensues to the crop is very great; the shelter afforded to birds and vermin, and the injury caused by the trees excluding the sun and air, and the roots extracting the nutriment and moisture, in many cases depreciating the produce from 10 to 20 per cent.

The roads being well maintained, give facility to improvements not found in many other counties, which the navigation also further enhances. These advantages have been made available by the spirited manner in which cultivation is carried out; and in many divisions it is not excelled, if equalled, by any other part of the kingdom; and, considering that leases are not general, it exhibits a confidence between landlord and tenant highly commendable. The proportion of farms under lease is below a moiety. These are held, for the most part, on terms of fourteen years.

The wages of labourers differ considerably in various districts, being fully one-third higher in those districts near London and towards the sea-coast. Those in the first described portion of the county vary from 8*s*. to 9*s*. per week; in the last described, the prevailing amount paid is 10*s*. to 12*s*., with wheat averaging 50*s*. The workmen are expert, particularly the ploughmen, who may fairly challenge any other county in the kingdom. The ploughs used are nearly all swing-ploughs, with cast-iron breasts and shares, and of various shapes, adapted to the nature of the soil, and worked by two horses abreast.

In conclusion, the soil of this county may be considered, for the most part, fertile, and with good cultivation yields excellent crops. The average of the wheat crop may be assumed at 28 bushels per acre, barley at 36, oats at 40, beans at 32, and peas at 28. It is impossible, where so much variety of soil exists, to state with precision, but the above may be taken as a fair criterion.

APPENDIX.

THE system of farming in this county, as well as in others, is varied according to the opinion of the cultivators; and without contending for the superiority of any system, I will state the course of cultivation pursued by Mr. King Viall upon several farms lying upon the borders of this and the neighbouring county of Suffolk. The land consists of three varieties of soil, being for the most part heavy land, as it is called in that district—a term, by the bye, that conveys no distinct idea of the quality of a soil, being rather adapted to distinguish land which consists mostly of clay from that which consists of gravel or sand. This portion of the farm consists of a chalky clay subsoil, having a considerable quantity of marl intermixed, with a tolerably deep staple of vegetable mould (combined with the clay) lying upon the surface, and is of that description of soil described in the first part of this essay. A second portion lying between the above-described land and the river is clay mixed with alluvial deposit, and loam and gravel prevailing more or less as a subsoil, of which the surface in some degree partakes, having a deeper staple than the first described portion of the farm, it is adapted to the growth of Swede turnips and mangold-wurzel. The remainder of the farm, in the proportion of about 10 acres to each hundred of arable, consists of meadow-ground liable to be flooded during winter, and some small enclosures of pasture adjoining the premises, which are situated nearly central to the farm, a hard road running through and dividing the strong clay-land from the turnip-land and belt of meadow-ground.

The system pursued is an expensive one, and requires great activity and experience to carry it out effectually, as in addition to the management of the land, a competent knowledge of the purchase and sale of sheep and cattle is involved, which is rarely combined with superior knowledge of cultivation in one individual. The land is all adapted to the growth of wheat, beans, barley, and oats, which are the crops produced in fair proportions in each year, every part of the farm being in crop at the same time.

To commence with the turnip-soil (or the last-described portion of the farm), the land is ploughed up as early as possible in the autumn, and receives one, two, or more ploughings, as opportunity offers. In the early part of the winter such portions as require draining are thoroughly drained with pipes of two inches' bore, having the opening heart-shaped—the widest part of which is placed downwards—upon the top of which stone is placed to about 3 inches in depth, consisting principally of small flints and pebbles, picked from the surface of the land; as soon as the land is sufficiently dry it receives two deep cross-ploughings early in the spring, is rolled and harrowed until a fine tilth is produced, and is then formed into ridges, or small stetches, 37 inches each in width, which is thus effected:—A straight furrow is first ploughed, and a double-breasted plough is then used, having a marking instrument attached, which consists of a small straight tough pole fixed at right angles from the beam of the plough by means of a hook, and placed as far back as possible, so that it does not derange the operation of the plough whilst working; at the end of this stick an iron is fixed exactly the width of two of the intended ridges, which is connected diagonally by a chain with the whipple-tree of the horse; this, as the plough proceeds, marks out the next furrow, occupying the space of two ridges. The work thus proceeds followed by a similar plough, or by the ploughman returning, who by passing his plough down the middle of this space divides the stetch of 6 feet 2 inches into two smaller ones of 37 inches each, the marker still defining the distance at which the plough should be held; the ridges being formed, are ploughed off with four furrows to each, and then every fifth ridge is drawn out to enable the manure to be carted on without injuring the form of the ridge. After the manure is carted on, at the rate of 16 loads of 40 bushels each, the ridges are then ploughed by four furrows, leaving a small baulk in the centre so as to divide the ridge into two spaces for the manure, which from being partially decomposed is easily spread in this double furrow; the land is then ploughed at four furrows to each ridge, and the manure being covered in, is rolled and harrowed, and is again rolled with a light roller. The turnips are then drilled—two rows upon each ridge 11 inches apart, at the rate of 4 pints to the acre, thus standing at alternate spaces of 11 inches and 26 inches between the rows. As soon as the turnips appear, they are singled out by boys and women at 15 inches apart, and are left standing diagonally with each other; they are then carefully and deeply hoed with a heavy hoe, and the furrows are kept clean with the horse-hoe, but the turnips are invariably set out by hand and never by the hoe, the deep hoeing that is given being considered a main point in the system over and above that pursued with the common light turnip-hoe: and the singling by hand is assisted by a small measured stick 15 inches in length, enabling the children employed to set the turnips out regularly and diagonally, so that when finished they stand thus ˙.˙.˙.

In the months of November and December the turnips are all pulled, avoiding the use of hooks or cutting instruments for trimming them, merely wringing off the tops and dislodging the greater portion of the earth attached to the fibres without cutting them. The turnips are then carted to the respective fields where they will be required for winter use, and one moiety of them is left in the field for using there; those left are put into heaps of about 40 bushels each, are thatched over with straw, and the earth shovelled up and placed round the heaps to the top, which ends in a point. Those taken from the field are carted to the headlands of other fields where they will be required, which are principally those upon which wheat was grown in the preceding year after clover. The old hurdles used for folding are then selected for this purpose; one is placed first at the end across the space to be occupied by the turnips, and two more are put at right angles, forming a space made by the double row of hurdles, in which the turnips are placed, taking care to cart them when dry, and adding more hurdles lengthwise until sufficient space is obtained, and the turnips are disposed of in rows about 7 feet wide and 4 feet in height. The turnips are then protected by the earth being dug up and placed on both sides, leaving air-holes at about 4 or 5 feet distance, level with the surface of the land, which may be formed as the work proceeds by introducing small faggots tied loosely, or by any other mode, leaving the sides of the whole open so as freely to admit air, and extending across from side to side, which is of especial importance towards the preservation of the turnips, as they might otherwise get into active fermentation, which when it takes place frequently destroys the greater part of them. The top of the heap is then covered with barley-straw and thatched, and thus the turnips are preserved from injury by frost and game during the most severe weather, and will remain in excellent condition until May following, very little impaired by keeping. The application of them is by feeding them upon the eddishes, and upon the land upon which they are grown by sheep in fold. The turnips are all sliced, and the sheep are regularly fed in troughs, having a new fold every day, and with from ½ lb. to 1 lb. each of oil-cake per day. The sheep, for the most part, consist of lambs of the last year, and cost from 16*s*. to 20*s*. each—these in the following spring are shorn and sent to market, and produce from 30*s*. to 32*s*. each; the fleeces from the half-bred Leicesters weighing each about 6½ lbs., and selling from 12*d*. to 16*d*. per lb.

Mangold-wurzel is grown upon the clay-land; the method of cultivating, elsewhere adverted to, (with one exception, that of growing upon 3-feet ridges) is carried out upon this farm, and the roots are used in conjunction with the turnips in the manner above stated, being all sliced and fed in troughs, and the quantity increased as the season advances, and the turnips become diminished. It is by this management that the land is maintained in a condition to produce crops without clear summer fallowing, and the hoeing becomes thus an important item in the farm management and expenditure, which, from being well carried out upon this farm, I shall advert to particularly. Gangs of boys from ten to fifteen years of age are constantly employed, at wages from 4*d*. to 8*d*. each per day; with every ten or more boys a man is placed, who is made responsible for their properly executing the work, and also for their application. Narrow hoes are used in preference to wide ones. The wheat, beans, and peas first receive attention, and are all thoroughly hoed and weeded at a cost of about 3*s*. to 4*s*. per acre; the boys also dibble in the mangold-seed, and single the plants of both that and the turnips ready for the hoe, weed all the Lent corn, each being furnished with a glove, and then assist in making the hay, shaking it out with their hands without using forks; the smallest are then released for the month of harvest to follow gleaning, and the largest are all kept to various work, such as hoeing and cleaning the turnips, and assisting in the harvest-work as required, but always accompanied by the man. As the season advances, the pulling and carting of the turnips again occupies them, and it is only during the depth of winter that the smallest are not employed. Frequently two or three gangs of from ten to fifteen in each gang are at work; the light hoeing is thus executed at a less cost than could be effected by men, and the boys are at the same time taught early to work and to become industrious. The system pursued as regards the corn-crops is as follows:—The land from which the turnips were taken, after having been folded with sheep, is immediately ploughed, provided the weather is dry enough, and remains until the following spring, when it is scarified and drilled with barley. The eddishes to which the turnips have been carted are also folded over with sheep, and are ploughed early and drilled with oats. The land sown with barley is also sown with clover-seed by a machine of peculiar construction, but admirably adapted. In the following year the land that had been in oats is ploughed two or three times in the autumn, and formed into 3-feet ridges, as before described for turnips, manured, and drilled with beans, three rows upon each ridge; these are well hoed during the summer. The clover succeeding the barley is reserved for hay, or fed until the middle of May, and both white and red varieties are then carefully weeded, rolled, and left for seed. The land in beans is in the next year drilled with wheat or barley, and that in clover is drilled with wheat. In the fourth year that portion of the wheat succeeding the clover is folded upon again with turnips as before, and in the succeeding year is sown again with oats; and that portion succeeding the beans is fallowed, and sown with mangold wurzel and Swede turnips. Thus a continual system of labour is kept up, occupying at the rate of six men to each 100 acres, with boys in addition at the rate of two men more: excellent crops are thus produced, the wheat averaging upwards of 4 quarters, the beans upwards of 5 quarters, the barley 6 quarters, and the oats 7 to 8 quarters per acre. The produce of the clover in seed also forms an important item in the returns, and gives a vast deal of employment in the winter-months; it is about 4 bushels of red and 6 bushels of white clover per acre. The neat stock consists of cows, which are used for dairy purposes, are fed upon grass in summer and oil-cake in winter, which is given in the cow-stalls three times in the day; those not in milk eat the blades of turnips occasionally, but the turnips are principally expended with the sheep.

The horses are of the light Suffolk breed, and fed in the summer upon grass, clover, and tares, and in the winter upon cut chaff or hay, and oats at the rate of [illegible] bushels to each horse throughout the whole year, with 2 trusses or [illegible] cwt. of hay each in the winter.

A considerable quantity of artificial manure is also used. Guano is most approved. Ground bones are also used, as well as rape-cake, and the kiln-dust from the malt-kilns, which is drilled between the barley.

A system prevails upon this farm, as well as upon other portions of the county, of applying the white chalk clay as a fertilizer to the surface: this is dug from pits, and upon fresh ploughed land has a very beneficial effect, acting as the chalk does upon the strong clay-lands, and tending towards the production of excellent crops, especially of wheat and barley.

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